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HATCH EXPERIMENT STATION

—OF THE—

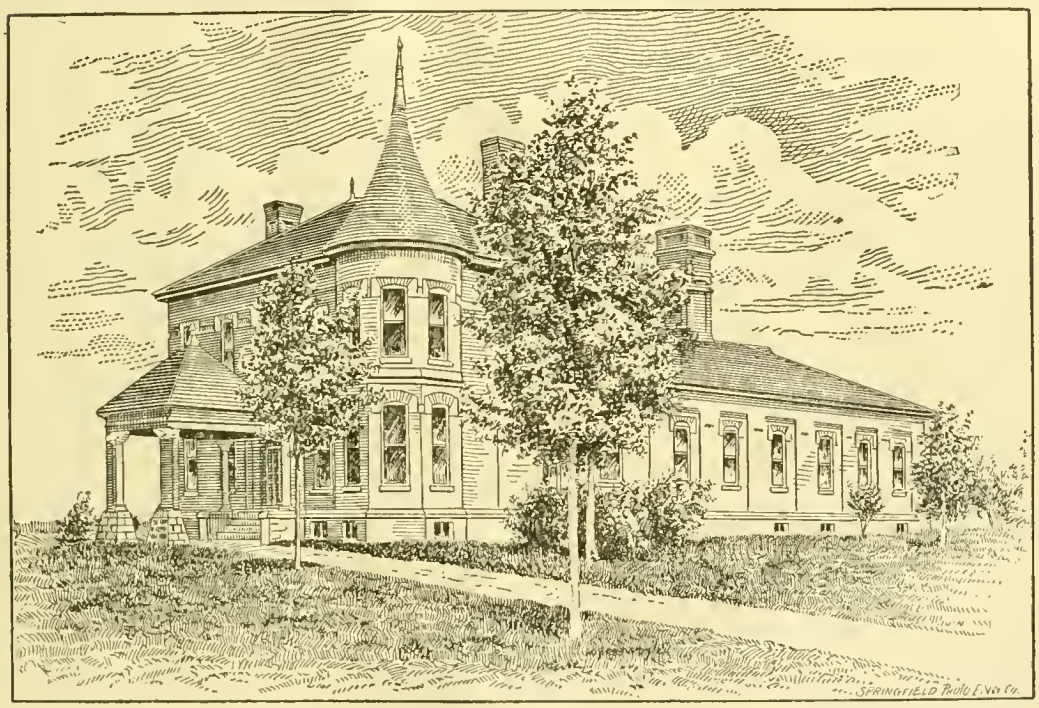
MASSACHUSETTS

AGRICULTURAL COLLEGE.

BULLETIN NO. 71.

CONCENTRATED FEED-STUFFS.

CONDIMENTAL AND STOCK POULTRY FOODS.



CHEMICAL LABORATORY.

JANUARY, 1901.

The Bulletins of this Station will be sent free to all newspapers in the State and to such individuals interested in farming as may request the same.

HATCH EXPERIMENT STATION

OF THE

Massachusetts Agricultural College,

AMHERST, MASS.

By act of the General Court, the Hatch Experiment Station and the State Experiment Station have been consolidated under the name of the Hatch Experiment Station of the Massachusetts Agricultural College. Several new divisions have been created and the scope of others has been enlarged. To the horticultural, has been added the duty of testing varieties of vegetables and seeds. The chemical has been divided, and a new division, "Foods and Feeding," has been established. The botanical, including plant physiology and disease, has been restored after temporary suspension.

The officers are :—

HENRY H. GOODELL, LL. D.,	*Director.*
WILLIAM P. BROOKS, PH. D.,	*Agriculturist.*
GEORGE E. STONE, PH. D.,	*Botanist.*
CHARLES A. GOESSMANN, PH. D., LL. D.,	*Chemist* (Fertilizers).
JOSEPH B. LINDSEY, PH. D.,	*Chemist* (Foods and Feeding).
CHARLES H. FERNALD, PH. D.,	*Entomologist.*
SAMUEL T. MAYNARD, B. SC.,	*Horticulturist.*
J. E. OSTRANDER, C. E.,	*Meteorologist.*
HENRY T. FERNALD, PH. D.,	*Associate Entomologist.*
HENRY M. THOMSON, B. SC.,	*Assistant Agriculturist.*
RALPH E. SMITH, B. SC.,	*Assistant Botanist.*
HENRI D. HASKINS, B. SC.,	*Assistant Chemist* (Fertilizers).
SAMUEL W. WILEY, B. SC.,	*Assistant Chemist* (Fertilizers).
JAMES E. HALLIGAN, B. SC.,	*Assistant Chemist* (Fertilizers).
EDWARD B. HOLLAND, M. SC.,	*First Chemist* (Foods and Feeding).
PHILIP H. SMITH, B. SC.,	*Ass't Chemist* (Foods and Feeding).
JAMES W. KELLOGG, B. SC.,	*Ass't Chemist* (Foods and Feeding).
GEORGE A. DREW, B. SC.,	*Assistant Horticulturist.*
HENRY L. CRANE, B. SC.,	*Assistant Horticulturist.*
CHARLES L. RICE,	*Observer.*

The co-operation and assistance of farmers, fruit-growers, horticulturists, and all interested, directly or indirectly, in agriculture, are earnestly requested. Communications may be addressed to the

HATCH EXPERIMENT STATION, Amherst, Mass.

DIVISION OF FOODS AND FEEDING.

JOSEPH B. LINDSEY.*

RESULTS AND SUGGESTIONS.

1. Of sixty-one samples of cottonseed meal collected, eleven were not guaranteed; eight of these latter were badly adulterated with fine ground hulls. *Farmers are urged to purchase only guaranteed meals.*

2. The gluten meals and feeds were free from adulteration and, with a few exceptions, of excellent quality. They are among the cheapest and best concentrated feeds.

3. Wheat bran and middlings were of good quality. A number of mixed feeds were adulterated with woody material similar to fine ground corn cobs. Farmers are at present strongly urged to carefully note in this bulletin the names of those brands of mixed feed showing an analysis of 16 or more per cent of protein, and to purchase accordingly.

4. A considerable portion of the oat feeds upon the market are of very inferior quality; most of them cost nearly as much as corn meal *and are only one-half to two-thirds as valuable.*

5. A large proportion of the corn and oat feeds, or provenders, consisted of mixtures of oat offal and corn meal. It would be economy to purchase the oats and corn separately and have them ground by the local miller.

6. Condimental stock foods consisted principally of cereals, wheat offal, and linseed meal, together with some condiment such as fenugreek, gentian, or fennel, as well as common salt, sulfates of magnesia and soda, charcoal, iron, and occasionally pepper and sulphur.

*Assisted by E. B. HOLLAND, P. H. SMITH JR., and J. W. KELLOGG.

7. Condimental poultry foods consisted of grain mixtures similar to those found in the stock foods, together with considerable quantities of fine ground oyster shells, charcoal, and pepper.

8. The condition powders varied materially in composition. One of the more prominent ones contained a large amount of linseed meal and charcoal, as well as Epsom salts, carbonate and phosphate of lime, pepper and ginger.

9. It is impossible for condimental foods to "prevent and cure diseases, make richer milk, and double the egg supply".

10. Attention is called to the article on Condimental Stock and Poultry Foods, and especially to the paper by Dr. J. B. Paige on the utility of such foods.

CONCENTRATED FEED STUFFS.

A. Classification.
B. Protein Standards.
C. Results of the Inspection.
D. Discussion of the Results.
E. The Best Feeds and the Best Rations.
F. Key to Comparative Values.

A. CLASSIFICATION OF CONCENTRATED FEEDS.

The following classification is made on the basis of the amount of *protein* contained in the several feed stuffs, those in Class I. showing the largest amount, and those in Class IV. the smallest quantity.

Division I. Protein Feeds.			Division II. Starchy (Carbohydrate) Feeds.
Class I.	Class II.	Class III.	Class IV.
30 *to* 45% *protein.* 50 to 60% carbohydra's.* 75 to 90% digestible.	20 *to* 30% *protein.* 60 to 70% carbohydra's.* 80 to 85% digestible.	14 *to* 20% *protein.* 70 to 75% carbohydra's.* 60 to 75% digestible.	8 *to* 14% *protein.* 75 to 85% carbohyd's.* 75 to 90% digestible.
Cottonseed meal. Cleveland flax meal. N. P. and O. P. linseed meals. Chicago, Cream, and King gluten meals.	Buffalo, Davenport, Golden, Rockford Diamond, Waukegan, and other standard gluten feeds. Atlas meal, dried brewers' grains, and malt sprouts.	Wheat middlings, mixed feed, and wheat bran. H. O. dairy feed.	Wheat, rye, barley, oat, corn, and hominy meals. Oat, corn and oat, and corn oat and barley feeds. Quaker dairy and H. O. horse feeds.

*Including fat reduced to carbohydrates.

B.

	FEED STUFF.	PROTEIN STANDARD.
Protein Feeds,	*Cottonseed meal,*	43 per cent.
	Cleveland flax meal,	38 "
	O. P. linseed meal,	36 "
	Gluten meal,†	36 "
	Gluten feed,	25 "
	Wheat middlings,	17–20 "
	Mixed feed,	16–17 "
	Wheat bran,	15–16 "
	Malt sprouts,	25 "
	Dried brewers' grains,	22 "
	H. O. dairy feed,	18 "
Starchy (carbohydrate) Feeds,	*Corn meal,*	9 "
	Hominy meal,	10–11 "
	Ground Oats,	11-12 "
	Oat feed,	8–10 "
	Quaker dairy feed,	12 "
	Corn and oat feed,	8–9 "
	Corn, oat, and barley feed,	11–12 "
	H. O. horse feed,	12 "
Poultry Feeds.	*American poultry feed,*	13 "
	H. O. poultry feed,	17 "
	Meat and bone meals,	40 "

†King gluten meal from the Demoines factory generally contains 33 per cent of protein and 15 per cent of fat, but that marked Buffalo, N. Y., shows much less fat.

C. RESULTS OF INSPECTION.

I. Protein Feeds.

Cottonseed Meal.

Brand.	Manufactured by:	Sampled at:	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat. %
	The American Cotton Oil Co.	Greenfield	43	9			
	" "	Needham	43	9	7.23	47.06	9.65
	" "	Orange	43	9			
	" "	Fitchburg	43	9			
	" "	Greenfield	43	9			
	" "	N. Wilbraham	43	9	6.63	44.85	10.13
	" "	Orange	43	9			
	" "	Southbridge	43	9			
Owl	F. W. Brodé & Co.	Ayer	43	9			
"	" "	S. Framingham	43	9			
"	" "	Westfield	43	9	6.23	43.91	13.36
"	" "	Westminster	—	—			
	Butler, Breed & Co.	Lawrence	43	9	6.86	48.78	10.39
	Chapin & Co.	Amherst	43	9			
	" "	Holyoke	43	9			
	" "	Northampton	43	9	6.93	46.35	9.92
	" "	Salem	43	9			
	" "	Westboro	43	9			
	Chattanooga Cotton Oil Co.	N. Wilbraham	8-8.50†	—	7.84	45.28	8.48
	Decatur Cotton Oil Co.	Middleboro	43	9-10	7.20	46.69	11.41
H. & B.	Hayley & Beine	S. Framingham	43	9-10	7.14	46.16	11.04
"	" "	Salem	43	9-10	7.56	44.63	12.19
Dixie	Humphreys, Goodwin & Co.	N. Amherst	43-48	9-11	6.09	47.41	11.23
	" "	Waltham	43	9	6.13	44.26	11.90
	Hunter Bros.	Southboro	43	9	6.49	46.31	10.79
	" "	Worcester	43	9			
	" "	Southboro	43	9	6.15	44.00	9.74
I—S.	Interstate Cotton Oil Co.	Fitchburg	7.59‡	—	7.51	45.81	8.16
Stock Food	Newbury Cottonseed Mill.	Fitchburg	—	—	7.86	47.69	10.20
	Geo. B. Robinson Jr.	Clinton	43	9	6.70	48.53	8.06
	J. E. Soper & Co.	Easthampton	43	9-10			
	" "	Lexington	43	9			
	" "	Springfield	43	9	7.49	43.63	11.28
	" "	Westfield	43	9-10			
	" "	Holyoke	43	9	7.15	44.07	10.82
	" "	Winchendon	43	9			
	F. S. Walton Co.	Natick	43	9	7.25	48.00	9.35
	W. L. Ward	Milbury	43	9	6.36	47.50	9.31
	E. B. Williams & Co.	Greenfield	43	9	7.36	43.97	8.99
	" "	N. Adams	43	9			
Sea Island	Unknown	Newburyport	—	—	7.83*	26.10*	6.61*
	"	Wakefield	—	—			
	"	Beverly	—	—	7.95*	27.85*	7.63*
	"	Brockton	—	—	7.44*	23.28*	9.45*
	"	Lynn	—	—	8.83*	25.00*	8.77*
	"	New Bedford	—	—	8.10*	27.22*	6.87*
	"	Taunton	—	—	7.99*	27.13*	6.68*
	"	Beverly	—	—	6.21	46.62	6.12
	"	Marlboro	—	—	8.10*	26.19*	6.90*
	"	Wakefield	—	—	7.44	39.35	15.34
	"	Waltham	46.12	9.20	6.95	42.69	14.64
		Highest,			8.83	48.78	15.34
		Lowest,			6.09	23.28	6.12
		Average,			7.09	45.28	10.62

†As Ammonia, equivalent to 41.14—43.71% protein.

‡As Ammonia, equivalent to 39.03% protein.

*Not included in the average.

Linseed Meal.

Brand.	Manufactured by:	Sampled at:	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat. %
		NEW PROCESS.					
Cleveland Flax	American Linseed Co.	Needham	—	—	8.19	38.75	2.70
" "	" "	New Bedford	38-40	—			
" "	" "	Southboro	38-40	—			
" "	" "	Adams	39-41	1.50-3	9.55	36.94	2.17
" "	" "	E. Weymouth	38-40	—	9.50	37.94	2.44
" "	" "	Southboro	—	—			
" "	" "	Taunton	—	—	9.45	38.63	2.27
	The Cutler Co.	Pittsfield	—	—	9.50	38.35	2.08
	Unknown	Chester	—	—	8.74	36.94	2.20
	"	Fitchburg	—	—	9.22	40.75	2.25
	"	N. Adams	—	—	9.52	40.13	2.25
	"	Palmer	—	—	9.55	38.35	2.37
	"	Amherst	38-40	1-3	9.82	37.22	2.81
	"	Fitchburg	—	—	9.17	36.69	2.34
	"	Northampton	—	—	9.48	38.82	2.57
	"	Palmer	—	—	8.85	36.88	2.80
	Average,				**9.15**	**38.24**	**2.44**
		OLD PROCESS.					
	Hunter Bros.	Northampton	—	—	8.47	35.19	7.81
	" "	Southbridge	—	—			
	Kellogg & Miller	Adams	36.70	7.83	9.01	36.35	6.35
	" "	Pittsfield	36.70	7.83	8.68	35.13	9.32
	Mann Bros.	Leominster	3-4*	—	8.82	36.32	6.06
	Wright & Hills	Amherst	—	—	7.84	37.13	5.88
	" "	Greenfield	—	—	7.73	36.94	7.01
	Unknown	Orange	—	—	9.47	32.13	7.00
	Average,				**8.56**	**35.55**	**7.14**

*As Ammonia equivalent to 15.43—20.57% protein.

Gluten Meal.

Chicago	The Glucose Sugar Refining Co.	Athol	36	3.37	9.51	39.78	1.84
"	" "	Chicopee	36	3.37			
"	" "	Clinton	36	3.37			
"	" "	Fitchburg	36	3.37			
"	" "	Northampton	36	3.37			
"	" "	Palmer	36	3.37			
"	" "	Pittsfield	36	3.37			
"	" "	Southbridge	36	3.37			
"	" "	Springfield	36	3.37			
"	" "	Wakefield	36	3.37			
"	" "	Amherst	36	3.37	8.00	39.81	2.57
"	" "	Athol	36	3.37			
"	" "	Newburyport	36	3.37			
"	" "	Shelburne Falls	36	3.37			
"	" "	Westboro	36	3.37			
"	" "	Chicopee Falls	39.50	3.37	7.92	39.69	1.95
"	" "	Southboro	39.50	3.37			
"	" "	Taunton	39.50	3.37			

(Continued.)

Gluten Meal (continued).

Brand.	Manufactured by:	Sampled at:	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat. %
Cream	Chas. Pope Glucose Co.	Adams	34.12	3.20			
"	" "	Chester	34.12	3.20			
"	" "	Chicopee Falls	37.12	3.20			
"	" "	Clinton	34.12	3.20			
"	" "	Hudson	34.12	3.20			
"	" "	Millbury	34.12	3.20	9.12	32.88	2.40
"	" "	Natick	34.12	3.20			
"	" "	N. Adams	34.12	3.20			
"	" "	Orange	34.12	3.20			
"	" "	Worcester	34.12	3.20			
"	" "	Worcester	34.12	3.20			
"	" "	Natick	34.12	3.20			
"	" "	Newburyport	34.12	3.20			
"	" "	N. Adams	34.12	3.20			
"	" "	N. Adams	34.12	3.20			
"	" "	N. Wilbraham	34.12	3.20	7.97	36.56	1.43
"	" "	Orange	34.12	3.20			
"	" "	Ware	34.12	3.20			
"	" "	Worcester	34.12	3.20			
King	The National Starch Mfg. Co.	Northampton	32.70	3.00	4.90	36.63	8.38
"	" "	Orange	—	—			
"	" "	N. Adams	32.40	3.70	8.52	38.19	1.90
"	" "	Middleboro	—	—	9.92*	29.19*	3.55*
"	" "	Middleboro	—	—	7.91*	28.97*	3.44*
"	" "	Orange	—	—	6.13*	33.13*	15.79*
	Average.....				**8.76**	**37.04**	**2.34**

*Not included in the average.

Gluten Feed.

Buffalo.	The Glucose Sugar Ref'ng Co.	Amherst	27.00	3.00			
"	" "	Chester	25.50	4.00			
"	" "	Concord	25.50	4.00			
"	" "	N. Brookfield	25.50	4.00			
"	" "	Rockland	25.50	4.00	9.13	26.19	2.85
"	" "	S. Framingham	—	—			
"	" "	Ware	—	—			
"	" "	Westfield	25.50	4.00			
"	" "	Woburn	25.50	4.00			
"	" "	Haverhill	25.50	4.00			
"	" "	Huntington	25.50	4.00			
"	" "	Rockland	25.50	4.00	8.98	26.69	2.21
"	" "	Shelburne Falls	25.50	4.00			
"	" "	Westfield	25.50	4.00			
"	" "	Amherst	27.00	3.00	8.41	26.97	2.84
"	" "	Amherst	27.00	3.00			
Davenport	" "	Palmer	25.50	4.00			
"	" "	S. Framingham	25.50	4.00	8.68	26.13	3.30
"	" "	Springfield	25.50	4.00			
"	" "	Lawrence	25.10	3.62	8.82	23.00	4.31

(Continued.)

Gluten Feed (continued).

Brand.	Manufactured by:	Sampled at:	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat. %
Rockford Diamond.	" "	Amherst	—	—			
" "	" "	Southboro	26.20	2.70	8.50	27.13	2.01
" "	" "	Southbridge	26.20	2.70			
Golden	" "	Newburyport	25.50	4.00	8.24	24.88	3.63
Glen Cove	The National Starch Mfg. Co.	Adams	28.40	4.30			
"	" "	Fitchburg	28.40	4.30			
"	" "	Holyoke	28.40	4.30			
"	" "	Southboro	28.40	4.30	8.58	27.19	3.05
"	" "	S. Deerfield	28.40	4.30			
"	" "	Westfield	28.40	4.30			
"	" "	Adams	28.40	4.30			
"	" "	Fitchburg	28.40	4.30			
"	" "	Southboro	28.40	4.30	7.29	27.53	3.06
"	" "	S. Deerfield	28.40	4.30			
"	" "	Wakefield	28.40	4.30			
Waukegan	U. S. Sugar Refining Co.	Gt. Barrington	27.38	3.39			
"	" "	Montague	27.38	3.39			
"	" "	New Bedford	27.38	3.39	8.87	24.41	3.13
"	" "	N. Wilbraham	27.38	3.39			
"	" "	Taunton	—	—			
"	" "	Amherst	—	—			
"	" "	Fitchburg	27.38	3.39			
"	" "	Greenfield	27.38	3.39			
"	" "	Holyoke	27.38	3.39	8.25	27.50	3.50
"	" "	N. Brookfield	—	—			
"	" "	Springfield	27.38	3.39			
"	" "	Westminster	27.38	3.39			
	Archer Starch Co.	Newburyport	—	—	9.09*	19.07*	3.98*
	Unknown	Lawrence	—	—	9.42	26.25	3.46
	"	Marlboro	—	—	7.77*	17.50*	4.16*
	Highest,				**9.42**	**27.53**	**4.31**
	Lowest,				**7.29**	**17.50**	**2.01**
	Average,				**8.58**	**25.92**	**2.99**

*Not included in the average.

Germ Oil Meal.

Manufactured by:	Sampled at:	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat %
The Glucose Sugar Refining Co.	Dalton	—	—			
" "	Leominster	—	—			
" "	Newburyport	—	—			
" "	Wakefield	—	—	9 77	22.63	10.13
" "	Walpole	—	—			
" "	Woburn	—	—			
" "	Concord	25.50	10.50			
" "	Gardner	—	—			
" "	Lawrence	25.50	10.50			
" "	Palmer	25.50	10.50	8.22	22.66	10.70
" "	Springfield	25.50	10.50			
" "	Westfield	25.50	10.50			
	Average,			**9.00**	**22.65**	**10.42**

Wheat Bran.

Brand.	Manufactured by:	Sampled at:	Moisture. %	Protein. %	Fat. %
	Bay State Milling Co.	Chicopee Falls	6.63	17.13	5.10
Choice	" "	Montague	8.72	16.06	5.17
Jersey	George C. Christian	New Bedford	8.67	16.31	5.41
"	" "	Springfield			
Michigan	Chas. M. Cox & Co.	Lawrence	7.13	15.94	4.58
Daisy	Daisy Roller Mills	Gardner	7.38	15.85	4.75
"	" "	Haverhill	8.82	13.38	4.08
Clean	J. G. Davis Co.	Gt. Barrington	7.71	16.00	5.22
	Hunter Bros.	Fall River	8.94	17.32	4.79
	" "	Ware			
	" "	Clinton	8.84	17.16	4.28
	Kehlor Bros.	N. Brookfield	8.12	17.13	4.71
	" "	Wakefield			
	" "	Palmer	8.42	17.56	4.65
	Minnesota Flour Mill Co.	Holyoke	9.30	16.81	5.08
	Northwestern Consol. Milling Co.	Salem	8.18	15.41	4.90
	C. A. Pillsbury	Adams	8.54	15.66	4.94
	" "	Pittsfield			
Pillsbury's	" "	S. Deerfield			
	" "	Haverhill	8.36	15.38	4.95
	" "	Pittsfield			
	" "	Pittsfield			
Pillsbury's B.	" "	Lexington	9.52	18.00	6.06
" "	" "	Athol	9.22	15.81	5.06
No. 1 Choice	M. G. Rankin & Co.	Beverly	8.95	16.81	5.12
	Henry Russell	Shelburne Falls	7.91	16.31	4.20
Coarse	The Sheffield Milling Co.	Amherst	8.67	15.47	5.25
	Simpson, Hendee & Co.	Gt. Barrington	8.75	16.81	4.25
	Sparks Milling Co.	Chicopee Falls	8.85	17.42	4.47
Star	Star & Crescent Milling Co.	Natick	8.15	16.53	5.09
Stott's	David Stott	Hudson	8.28	15.44	4.68
Michigan Winter	Valley City Milling Co.	Newburyport	8.20	15.85	4.93
Winter	" "	Adams	8.19	15.44	4.74
Michigan Winter	" "	Haverhill			
Choice	" "	Southbridge	8.25	16.56	4.72
	The Voigt Milling Co.	Northampton	9.64	16.88	4.57
	Walnut Creek Milling Co.	Westminster	8.80	16.50	4.24
Coarse	Washburn, Crosby Co.	Amherst	8.48	16.35	5.08
"	" "	Chester			
"	" "	Leominster			
"	" "	Springfield	8.28	14.69	5.01
Snowflake	E. S. Woodworth & Co.	Westminster	8.74	14.94	4.97
	Zenith Milling Co.	Lowell	8.47	16.28	4.70
Canada	Unknown	Needham	9.32	13 56	4.39
"	"	Westboro	9.29	13.91	4.67
U. S.	"	Montague	8.77	15.41	3.89
	"	Athol	9.23	15.44	4.89
	"	Dalton	8.24	17.81	4.72
	"	E. Brookfield	9.82	14.81	5.32
	"	Fitchburg	7.03	18.06	4.89
	"	Fitchburg	8.57	16.81	3.93
	"	Palmer	8.16	16.75	4.65
	"	Chicopee	8.77	16.78	5.15
	"	E. Brookfield	9.49	17.60	4.32
	"	Fitchburg	8.88	17.66	4.18
	"	Haverhill	8.93	15.25	4.76
	"	Montague	9.27	15.44	4.50
	"	Northampton	9.31	16.88	4.91
	"	Orange	8.98	15.85	5.03
	"	Westfield	9.06	17.16	4.66
	Highest,		**9.82**	**18.06**	**6.06**
	Lowest,		**6.63**	**13.38**	**3.89**
	Average,		**8.75**	**16.17**	**4.80**

Wheat Middlings.

Brand.	Manufactured by:	Sampled at:	Moisture. %	Protein. %	Fat. %
Andrews	Andrews & Co.	Gt. Barrington	10.16	19.60	5.34
"	" "	Natick			
Dexter	Chapin & Co.	Lexington	9.69	18.69	5.21
"	" "	Springfield			
Windsor	" "	Amherst	8.78	19.16	5.66
	Cumberland Mills	Fitchburg	8.87	18.47	5.62
Daisy Flour	Daisy Roller Mills	Athol	9.43	18.69	5.03
Daisy	" "	Chicopee Falls			
"	" "	Waltham			
Best	J. G. Davis Co.	Pittsfield	8.44	18.28	5.87
"	" "	Gt. Barrington	8.98	18.06	6.15
Winter	Hart Bros.	Salem	10.31	15 91	4.59
"	Hunter Bros.	Fitchburg	9.34	18.06	4.96
"	" "	Ware			
Shorts	Listman Mill Co.	New Bedford	9.00	17.16	5.54
Colonial	Miner-Hillard Milling Co.*	Ware	8.69	12.50	7.07
Flour	Minneapolis Flour Mfg. Co.	Lowell	9.34	18.91	5.28
Shorts	Missouri Valley Milling Co.	New Bedford	9.60	18.91	5.77
Comet	Northwestern Consol. Milling Co.	Marlboro	9.62	20.47	5.10
"	" "	Westboro			
"	" "	Worcester			
"	" "	Fitchburg	9.30	20.28	5.61
"	" "	Winchendon			
Flour	" "	North Adams	10.20	19.13	5.91
	" "	E. Brookfield	9.16	17.60	5.80
	" "	Lowell			
	" "	Natick			
	" "	Millbury	7.75	17.88	5.53
	" "	Newburyport			
	" "	North Adams			
	" "	Worcester			
Daisy XX.	C. A. Pillsbury	Fitchburg	9.45	19.38	5.47
Daisy	" "	N. Wilbraham			
"	" "	Taunton			
Daisy XX.	" "	Southbridge	8.05	19.38	5.39
A.	" "	Holyoke	8.18	18.91	6.00
"	" "	Orange			
B.	" "	N. Amherst	9.94	17.38	5.85
"	" "	S. Framingham			
"	" "	Southbridge			
"	" "	Adams	8.85	17.22	7.13
"	" "	Dalton			
Flour	The Sheffield Milling Co.	Concord	10.44	19 44	6.48
"	" "	Dalton	8.95	19.81	5.93
"	" "	North Adams			
"	" "	Taunton			
"	" "	Ware			
"	" "	Winchendon			
	E. O. Stanard Milling Co.	N. Brookfield	10.13	18.75	4.47
Star	Star & Crescent Milling Co.	Natick	9.09	18.69	5.48
	Stratton & Co.†	Woburn	10.26	15.22	4.22
Fancy	The Geo Tileston Milling Co.	Northampton	10.41	18.00	6.02
Choice Winter	Valley City Milling Co.	Adams	10.06	16.13	4.25
" "	" "	Fitchburg			
Adrian	Washburn Crosby Co.	Chester	9.46	18.72	4.80
Adriance	" "	Amherst	9.56	19.81	4.71
Flour	" "	Northampton	10.40	19.25	5.06
"	" "	S. Deerfield			

Brand.	Manufactured by	Sampled at	Moisture. %	Protein. %	Fat. %
Standard	" "	Palmer	10.27	18.00	5.43
"	" "	S. Deerfield			
"	" "	Easthampton	9.05	18.44	5.30
	" "	N. Amherst	9.16	19.16	5.56
Snow's Flour	E. S. Woodworth & Co.	Amherst	10.47	18.31	5.07
Snow's Cream	" "	Huntington	8.83	20.00	5.41
Monogram	Unknown	Lowell	8.75	18.31	5.19
New York	"	Fall River	8.71	17.25	5.32
	"	Beverly	9.70	18.94	5.46
	"	Chicopee	10.08	19.31	5.37
	"	Dalton	9.43	16.81	5.50
Red Dog Flour	"	Gardner	10.55	18.82	4.75
Winter	"	New Bedford	10.52	20.19	5.18
	"	Pittsfield	10.03	17.25	5.05
	"	Chicopee	8.45	17.60	5.14
Red Dog	"	Clinton	10.11	18.47	4.57
	"	E. Brookfield	9.59	18.69	4.15
	"	Holyoke	9.88	15 50	2.62
	"	Huntington	8.33	18.00	4.84
Winter	"	Marlboro	9.26	19.31	5.11
"	"	Montague	9.24	17.94	4.61
	"	Northampton	9.06	16.56	3.62
	"	Salem	9.37	17.85	5.30
	"	Ware	9.16	18.19	4.94
Red Dog	"	Westboro	9.71	18.47	4.89
Spring	"	Winchendon	8.96	18.28	5.68
	Highest,		**10.55**	**20.47**	**7.07**
	Lowest,		**7.75**	**12.50**	**2.62**
	Average,		**9.13**	**18.82**	**5.54**

*Guaranty Protein 13.56%. Fat 6.83. This is not pure wheat middlings but contains a mixture of hominy chop.

†Quite inferior to first class middlings.

Mixed Feeds.

Acme	Acme Milling Co.	E. Brookfield	9.14	16.97	4.90
"	" "	Natick			
"	" "	Needham			
"	" "	Shelburne Falls			
"	" "	E. Brookfield	9.07	18.00	4.51
"	" "	Huntington			
"	" "	Natick			
"	" "	Shelburne Falls			
Buckeye	The American Cereal Co.	Brockton	10.50	17.75	4.84
"	" "	Lawrence			
"	" "	Springfield			
"	" "	Dalton	9.54	17.63	4.54
"	" "	Westminster			
	Ansted & Burke Co.	Newburyport	9.97	16.35	4.36
Bay State	Bay State Milling Co.	Greenfield	6.55	17.66	5.42
"	" "	Orange			
"	" "	Newburyport	9.37	17.25	5.12
Badger	Berger-Anderson Co.	N. Brookfield	9.05	17.32	5.33
"	" "	Orange			
"	" "	Southboro			
"	" "	Ware			
"	" "	Westminster			
Blish	The Blish Milling Co.	Haverhill	7.92	17.22	5.00
"	" "	Lawrence			
Royal	Brooks-Griffiths Co.	Dalton	9.60	17.88	4.92
	" "	Westboro	8.60	17.07	5.04
Central	Central Milling Co.	Ware	7.96	16.78	5.48
Hamilton	Chapin & Co.	Chicopee	8.55	17.66	4.82

Brand.	Manufactured by :	Sampled at :	Moisture. %	Protein. %	Fat. %
Sterling	" "	Worcester	8.02	17.22	4.80
"	" "	Worcester			
"	" "	Fitchburg	9.39	16.69	4.55
Winter	" "	Rockland	8.76	17.00	5.33
"	" "	S. Framingham			
	— Cook	Southbridge	8.88	17.44	4.42
	"	"	9.09	16.97	4.09
	Chas. M. Cox & Co.	Fitchburg			
	" "†	Waltham			
Jersey	" "	Haverhill	8.14	17.07	5.05
"	" "	Wakefield			
Webster	" "	Lawrence			
Jersey	" "	Baldwinsville			
"	" "	Lowell	9.09	16.35	4.68
"	" "	Westfield			
	" "	"	8.93	18.00	4.48
XX.	" "	Easthampton			
"	" "	Haverhill	7.84	17.69	5.50
"	" "	Walpole			
Daisy	Daisy Roller Mills††	Clinton	9.43	16.94	5.03
"	" "	Holyoke			
"	" "	Fitchburg	8.46	16.72	5.00
Boston	Duluth Imperial Mill Co.	"	9.51	17.25	5.05
"	" "	S. Framingham			
Hoosier	Geo. F. Evans	Chicopee	9.42	17.19	4.51
New England	Freeman Milling Co.	Fitchburg	9.02	16.38	5.19
" "	" "	Orange			
" "	" "	S. Deerfield			
Mixed Dairy	Gem Milling Co.	Lowell	9.12	17.38	4.63
Columbia	Grafton Roller Mill	Worcester	9.75	16.44	5.30
Mill	Hannibal Milling Co.	Chester	10.31	17.00	4.77
	" "	Gt. Barrington			
	" "	Middleboro	8.63	16.63	4.53
	The Isaac Harter Co.	Amherst			
	" "	Gt. Barrington			
Harter's	" "	Lawrence			
	" "	S. Framingham	9.39	16.10	4.19
	" "	Walpole			
	" "	Westfield			
	" "	Worcester			
Harter's	" "	Brockton	8.79	16.50	4.55
"	" "	Fitchburg			
	" "	Shelburne Falls			
	Hollister, Chase Co	Amherst	9.38	17.00	5.42
Kentucky	" "	Dalton	7.95*	12.60*	3.16*
	The Holly Milling Co.	Taunton	9.60	15.66	4.32
Excelsior	Hunter Bros.	N. Brookfield	8.71	18.00	4.64
Sunshine	" "	Leominster	9.29	18.50	4.23
	" "	Fall River	8.82	17.25	4.15
	" "	Lynn	8.99	16.38	4.41
	" "	Southbridge			
	" "	Westfield			
	" "	Worcester			
H. B.	" "	Montague	9.49	16.97	4.20
Superior	Lake Superior Mills	Amherst	8.96	16.63	4.78
"	" "	"			
"	" "	Taunton			
"	" "	S. Framingham	9.30	16.63	5.29
Snowflake	Lawrenceburg Roller Mills Co.	Brockton	8.80	16.97	4.35
"	" "	Lawrence			

Brand.	Manufactured by:	Sampled at:	Moisture. %	Protein. %	Fat. %
"	" "	Easthampton			
"	" "	Fall River			
"	" "	Haverhill	9.44	17.50	4.64
"	" "	Millbury			
Lexington	Lexington Roller Mills Co.'	Winchendon	9.63	14.60‡	6.04
Hiawatha	Wm. Listman Milling Co.	Millbury	9.48	16.63	5.10
Standard	Lull-Franke Grain Co.	Greenfield	9.10	17.22	5.00
King	R. P. Moore Milling Co.	Montague	8.96	17.19	4.29
	New York Mills	Gt. Barrington	7.89	17.19	4.97
Fancy	C. A. Pillsbury	Amherst	7.53	16.06	5.17
"	" "	S. Framingham	9.78	16.69	4.92
Rex	The Rex Mill Co.	Haverhill	7.50	18.44	4.08
"	" "	Fitchburg			
	" "	Wilbraham	9.25	17.50	4.76
Rex	" "	Walpole			
Sharp's	Sharp's Milling Co.	N. Brookfield	10.05	17.13	4.12
Angola	Simpson, Hendee & Co.†	Holyoke	7.17	17.25	4.90
Columbia	J. E. Soper & Co.	Worcester	10.64	16.31	5.28
Victoria	St. Louis Victoria Flour Mills	S. Deerfield	8.04	18.13	4.59
"	" " "	Fitchburg	10.50	17.66	4.67
Farmer's Favorite Cow	Valley City Milling Co.	Newburyport	7.86	15.44	4.98
Cow	" "	Gt. Barrington	9.87	15.47	4.38
"	" "	Southbridge			
	Williams Bros.	Rockland	10.59	14.97‡	3.26
	The Walsh DeRoo Milling Co.	Southboro	8.18	15.63	4.72
Superior	Washburn Crosby Co.	Chester			
"	" "	Fitchburg			
"	" "	Leominster	7.15	18.03	5.34
"	" "	N. Brookfield			
"	" "	N. Wilbraham			
"	" "	Haverhill	9.61	17.06	4.97
"	" "	S. Amherst			
Standard	" "	"	9.64	17.63	4.94
	" "	Baldwinsville	9.50	16.81	5.21
Faist's	Unknown	Holyoke			
"	"	Needham			
"	"	N. Wilbraham	8.80	18.10	4.87
"	"	S. Framingham			
"	"	Taunton			
"	"	Webster			
Kauffman's	"	Worcester	9.77	17.22	4.31
Kansas	"	New Bedford			
"	"	Salem	9.01	15.94	4.02
"	"	"			
"	"	Wakefield			
Kentucky	"	Brockton	9 53	17.38	4.55
"	"	Taunton			
Monogram	"	Fitchburg			
"	"	Huntington	8.84	17.13	5.31
"	"	Ware			
National	"	Lowell	8.22	16.69	4.81
New Hampshire	"	Fall River	9.41	17.41	4.02
Purity	"	Waltham	8.84*	11.63*	3.46*
Russell's	"	Athol			
"	"	Concord	9.25	17.32	4.95
"	"	Fitchburg			
Triplex Extra	"	Millbury	9.07	17.56	5.23
F.	"	New Bedford	10.48	16 00	5.32
SS.	"	"	9.17	16.69	4.44
S.	"	"	9.17	16.78	4.98
Ground Wheat	"	Worcester	7.64	17.41	4.76

Brand.	Manufactured by:	Sampled at:	Moisture. %	Protein. %	Fat. %
" "	"	Concord	8.58	17.60	4.37
" "	"	"	8.20	16.28	4.64
" "	"	Rockland	8.80	16.69	4.68
" "	"	Walpole	8.87	16.35	4.62
Wheat	"	Leominster	9.10	17.16	5.11
Heavy	"	Fitchburg	8.72	16.35	4.24
	"	Brockton	8.33	16.88	4.73
	"	Lynn	9.33	17.32	5.34
	"	Millbury	7.94	16.72	5.60
	"	S. Amherst	8.29*	11.56*	3.74*
	"	Westboro	8.62	16.88	5.07
	"	Athol	8.16*	12.94*	3.41*
	"	Brockton	9.37	17.88	4.24
	"	Chicopee	9.38	17.81	4.53
	"	Clinton	8.56	17.66	5.17
	"	E. Weymouth	9.60	16 35	4.40
	"	"	8.78	14.97‡	3.93
	"	Fall River	8.68	16.94	4.17
	"	Fitchburg	9.08	17.38	4.32
	"	Lawrence	9.26	18.00	4 40
	"	"	9.22	16.78	4.31
	"	Lowell	8.64	17.50	4.86
	"	Marlboro	9 64	17.66	4.46
	"	Natick	9.03	15.85	4.42
	"	New Bedford	8.14	16.44	4.87
	"	N. Wilbraham	8.56	17.22	4.48
	"	Orange	7.63	13.82‡	3.60
	"	S. Framingham	9.63	17.00	4.93
	"	Walpole	8.92	16.78	4.68
	"	Westminster	8.00	13.50‡	4.00
	"	Westboro	8.90	15.94	4.69
	"	Holyoke	9.20	16.72	4.32
	"	Newburyport			
	Highest,		10.64	18.44	6.04
	Lowest,		6.55	11.56	3.16
	Average,		8.71	17.00	4.63

* Not included in the average; adulterated.
† Guaranty Protein 16.61% Fat 5.48.
†† Guaranty Protein 16.50% Fat 4.50.
‡ Inferior.

Dairy and Miscellaneous Feeds.

Brand.	Manufactured by:	Sampled at:	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat. %
Sucrene Dairy	American Milling Co.	Brockton	16.50	3.50			
" "	" "	Clinton	16.50	3.50			
" "	" "	Lawrence	16.50	3.50	8.88	16.72	3.07
" "	" "	Natick	16.50	3.50			
" "	" "	Newburyport	16.50	3.50			
H. O. Dairy	The H-O. Co.	Wakefield	18.00	4.50			
" "	" "	Worcester	18.00	4.50	7.35	18.31	3.85
" "	" "	Lowell	18.00	4 50			
" "	" "	Newburyport	18.00	4.50	7.43	18.94	4.53
Brewer's Grains	E. P. Mueller	Needham	—	—	5.39	31.56	6.50
" "	Unknown	Waltham	—	—	6.39	13.75	3.49
Distiller's "	J. W. Biles Co.	Salem	—	—	7.38	29.94	11.38
Malt Sprouts	Unknown	"	—	—	10.46	24.63	1.56
Sucrene Oil Meal	American Milling Co.	Natick	25.00	3.50			
" "	" "	Newburyport	25.00	3.50	10.41	21.28	2.79
Buckwheat Feed	C. F. Birkett	N. Brookfield	—	—	8.61	32.41	8.58
Proteina	A. Culver	Rockland	—	—	8.09	26.44	4.43

II. Starchy (Carbohydrate) Feeds.

Corn Meal.

Brand.	Manufactured by:	Sampled at:	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat. %
	Chas. M. Cox & Co.	Amherst	—	—	12.56	9.35	3.53
Sterling	M. L. Crittenden	Waltham	11.12	6.46	9.10	9.16	4.41
	Cutler Co.	E. Brookfield	—	—	12.42	9.56	4.10
	Eames & Towne	Holyoke	—	—	12.12	9.78	3.73
	Garland & Lincoln	Millbury	—	—	10.97	8.72	2.08
	J. L. Holley	Amherst	—	—	10.93	10.38	4.32
	H. C. Puffer & Co.	Westfield	—	—	13.62	9.60	3.32
	" "	E. Brookfield	—	—	10.99	9.60	3.84
	Average,				**11.59**	**9.52**	**3.67**

Hominy Meal.

Brand.	Manufactured by:	Sampled at:	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat. %
	Chas. M. Cox & Co.	Wakefield	—	—	10.28	10.50	7.60
	Shellabarger Mill & Elev.	Montague	—	—	7.18	11.75	10.19
	Suffern, Hunt & Co.	Fitchburg	—	—	9.03	11.19	9.15
	" "	Salem	11.02	7.70	8.66	11.50	10.10
	Unknown	Concord	—	—	8.70	11.31	9.02
	"	Fall River	—	—	8.85	11.00	7.68
	"	Worcester	—	—	9.80	10.88	7.13
	"	Concord	—	—	7.81	11.97	10.41
	"	Gt. Barrington	—	—	7.11	11.63	10.41
	"	Westminster	—	—	8.88	11.00	8.90
	"	Worcester	—	—	8.56	10.88	7.68
	Average,				**8.62**	**11.24**	**8.93**

Oat Feed.

Brand.	Manufactured by:	Sampled at:	Moisture. %	Protein. %	Fat. %
Vim	The American Cereal Co.	N. Adams	6.52	5.38	2.12
"	" "	Taunton			
	M. L. Crittenden	Worcester	7.13	6.19	1.95
Magnolia	Rodney J. Hardy & Sons	Fitchburg	7.06	8.47	3.90
"	" "	Adams	6.87	7.44	2.97
"	" "	Lowell			
"	" "	Westminster			
Oatena	The Illinois Cereal Co.	Rockland	7.52	6.94	2.25
"	" "	Worcester	5.91	5.66	1.68
Friend's Conc' Dairy	Muscatine Oat Meal Co.	Lowell	6.60	9.16	4.08
" "	" "	Middleboro			
" "	" "	Orange			
" "	" "	Gardner	5.62	8.06	3.14
" "	" "	Holyoke			
" "	" "*	Wakefield			
Linconshire	D. K. Reed & Son	Waltham	5.91	5.88	2.18
"	" "	Westboro			
Linconshire Fancy	" "	Wakefield	6.13	7.38	3.06
" "	" "	Westboro			
" "	" "	Lynn	6.78	6.69	2.49
" "	" "	S. Deerfield			
Argyle	Unknown	Rockland	5.63	7.07	2.72
Canada	"	Wakefield	5.31	1.72	0.78
"	"	Lynn	7.11	1.50	0.52
"	"	Wakefield	4.97	1.88	0.75
Dexter	"	Baldwinsville	5.34	8.03	3.45
Joliet	"	Lexington	7.02	5.06	1.86
	"	Fall River	5.37	7.75	3.23
	"	Lynn	4.22	2 66	1.33
	"	Fitchburg	6.47	6.56	2.51
	"	"	7.81	6.10	1.90
	"	Lexington	7.27	7.60	2.72
Middlings	"	Salem	5.71	16.56	7.61
"	"	Wakefield	6.81	13.31	6.31
	Highest,		**7.81**	**16.56**	**7.61**
	Lowest,		**4.22**	**1.50**	**.52**
	Average,		**6.31**	**6.92**	**2.79**

*Guaranty. Protein, 10.97%. Fat, 3.70%.

Quaker Dairy Feed.

Brand.	Manufactured by:	Sampled at:	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat. %
Quaker	The American Cereal Co.	Gardner	12.03	2.50			
"	" "	N. Amherst	12.03	2.50			
"	" "	N. Wilbraham	—	—			
"	" "	Southbridge	—	—			
"	" "	Taunton	12.03	2.50	7.73	13.82	3.26
"	" "	Wakefield	—	—			
"	" "	Westfield	12.03	2.50			
"	" "	Worcester	12.03	2.50			
"	" "	"	—	—			
"	" "	Amherst	12.03	2.50			
"	" "	Chicopee Falls	12.03	2.50			
"	" "	Easthampton	12.03	2.50			
"	" "	Natick	12.03	2.50			
"	" "	Newburyport	—	—	7.33	13.19	2.98
"	" "	N. Amherst	12.03	2.50			
"	" "	N. Wilbraham	12.03	2.50			
"	" "	S. Deerfield	12.03	2.50			
"	" "	Winchendon	—	—			
	Average,				**7.53**	**13.51**	**3.12**

Corn and Oat Feed. Provender.

Brand.	Manufactured by:	Sampled at:	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat. %
No. 1.	Akron Cereal Co.	Taunton	7.94	4.18	8.23	8.31	4.70
Victor	The American Cereal Co.	Chicopee Falls	—	—			
"	" "	Gardner	8.23	2.00			
"	" "	Holyoke	8.28	3.00			
"	" "	Lowell	8.23	3.00	9.75	8.38	3.62
"	" "	N. Amherst	8.23	3.00			
"	" "	Springfield	8.29	3.00			
"	" "	Webster	8.23	3.00			
"	" "	Athol	—	—			
"	" "	Gt. Barrington	8.23	3.00			
"	" "	Marlboro	—	—			
"	" "	Natick	8.23	3.00			
"	" "	N. Adams	8.23	3.00	9.21	8.56	3.70
"	" "	N. Amherst	8.23	3.00			
"	" "	Taunton	—	—			
"	" "	S. Amherst	8.23	3.00			
"	" "	Westboro	8.23	3.00			
999	M. L. Crittenden	Athol	—	—	9.16	10.13	2.79
Superior Cow	" "	Adams	—	—			
	" "	Fitchburg	—	—	9.89	7.81	2.75
Sterling	" "	Salem	—	—			
"	" "	Beverly	—	—			
"	" "	Salem	—	—	7.24	7.22	3.82
	Garland & Lincoln	Millbury	—	—	8.90	10.85	3.95
Lenox	Rodney J. Hardy & Sons	Huntington	—	—			
"	" "	Worcester	—	—	7.72	7.75	2.45
Windsor	" "	Lowell	—	—	8.71	7.44	2.27
"	" "	Westminster	—	—	7.78	7.85	2.50
	W. H. Haskell & Co.	Waltham	9.62	7.66	8.15	10.06	7.03
De Fi	The H-O Co.	N. Adams	8.30	3.00			
"	" "	"	—	—			
"	" "	Salem	8.30	3.00	9.52	8.10	2.55
"	" "	S. Framingham	8.30	3.00			
"	" "	Gardner	—	—	7.98	8.72	2.98
H.O Horse	" "	Greenfield	12.00	4.50			
"	" "	Salem	12.00	4.50	9.74	12.32	3.48
"	" "	Greenfield	12.00	4.50			
"	" "	Salem	12.00	4.50	8.22	13.47	3.84
	J. L. Holley	Amherst	—	—	10.40	10.44	4.40
	H. G. & G. D. Messerve	Easthampton	—	—	11.61	10.38	3.62
Durham	David Oliver	Lexington	—	—	8.87	8.13	3.02
	R. C. Snow	Ware	—	—	9.12	10.00	4.06
	Unknown	Fitchburg	—	—	8.21	7.19	2.48
	Highest,				**11.61**	**13.47**	**7.03**
	Lowest,				**7.24**	**7.19**	**2.27**
	Average,				**9.09**	**8.92**	**3.44**

Corn, Oat and Barley Feed.

Schumacher's	The American Cereal Co.	Brockton	—	—			
"	" "	Pittsfield	—	—			
"	" "	Rockland	—	—			
"	" "	Springfield	—	—	8.02	11.13	4.68
"	" "	Taunton	—	—			
"	" "	Webster	—	—			
"	" "	Worcester	—	—			
"	" "	Adams	10.79	3.28			
"	" "	Brockton	—	—			
"	" "	Pittsfield	10.79	3.28	6.92	11.53	4.66
"	" "	"	10.79	3.28			
"	" "	S. Amherst	10.79	3.28			
"	" "	Worcester	—	—			
	Average,				**7.51**	**11.31**	**4.67**

Miscellaneous Feeds.

Brand.	Manufactured by:	Sampled at:	Moisture. %	Protein. %	Fat. %
Barley Feed	Unknown	Wakefield	9.53	11.38	2.98
Corn and Cob Meal	A. J. Goddard	N. Brookfield	10.58	10.06	3.74
Corn Bran	O. D. Wilder	Lowell	8.84	5.25	1.55
Ground Oats	Rufus Covell	Shelburne Falls	7.97	9 97	3.78
"	E. A. Cowee	Hudson	6.50	11.19	3.82
"	C. B. Sawin & Son	Southboro	7.79	11.97	4 95
Rye Feed	Hollister Chase & Co.	Shelburne Falls	8.89	10.03	3.05
Rye Middlings	H. C. Puffer	Westfield	9.03	14 94	3.29
Mellen's Food	Mellin's Food Co.	Needham	7.23	11.44	3.41

III. Poultry Feeds.

Brand.	Manufactured by:	Sampled at:	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat. %
American	The American Cereal Co.	Athol	—	—			
"	" "	Chicopee Falls	—	—			
"	" "	Natick	—	—	7.47	13.10	5.51
"	" "	Needham	—	—			
"	" "	Springfield	—	—			
"	" "	Amherst	—	—	8.73	13.60	6.95
"	" "	Lawrence	—	—			
Blended Grain	C. H. Felker	Taunton	—	—	10.01	11.94	3.05
H-O.	The H-O. Co.	Greenfield	17.00	5.50	9.36	17.16	5.30
"	" "	Leominster	17.00	5.50			
"	" "	Salem	17.00	5.50	8.40	17.88	5.16
Poultry Hash	Ropes Bros.	"	—	—	9.63	15.57	4.45
Scratching Food	H. K. Webster & Co.	Lawrence	—	—	9.22	11.28	2.78

Meat and Bone Meal.

Raw Ground Bone*	C. A. Bartlett	Worcester	—	—	7.89	23.97	0.32
Steamed " "	" "	"	—	—	3.61	20.63	9.11
O. K. Poultry	" "	"	—	—	5.78	51.99	12.50
Meat and Bone Meal	Beach Soap Co.	Northampton	—	—	5.08	28.91	9.11
" "	" "	Lawrence	—	—	5.00	34.56	10.32
Animal Meal	Bowker Fertilizer Co.	Greenfield	—	—			
" "	" "	Millbury	—	—	6.85	44.16	8.53
" "	" "	Needham	—	—			
" "	" "	Adams	—	—			
" "	" "	Gardner	—	—	5.45	40.38	8.75
Superior Meat Meal	Bradley Fertilizer Co.	Greenfield	—	—	8.63	53.97	9.29
Meat Meal	" "	Orange	—	—	7.95	54.54	7.82
Ground Beef Scrap	John C. Dow	Natick	—	—	9.70	54.23	16.52
Poultry Meal	" "	Newburyport	—	—	9.41	30.82	9.75
Poultry Scraps	J. Lederer & Co.	Fall River	51-55	10-15	9.30	41.06	14.98
Swift's Bone, Meat M'l	Lowell Fertilizer Co.	Brockton	—	—	5.35	37.44	9.87
Lord's Beef Scraps	Unknown	Lawrence	—	—	6.18	49.69	18.51
Poultry Food	George E. Marsh & Co.	Wakefield	—	—	6.66	37.13	7.72
Beef Scraps	" "	Winchendon	—	—	9.75	51.60	13.02
Bone and Meat Meal	Rogers Mfg. Co.	Webster	—	—	5.13	35.03	10.04
Beef Scraps.	Ross Bros.	"	—	—	6.83	41.19	18.42
	Average,.....				**7.48**	**40.63**	**10.50**

*This material is vegetable ivory.

D. DISCUSSION OF THE RESULTS.

I. Protein Feeds.

Cotton and linseed meals. Most of the cottonseed meals are now branded, marked with the manufacturer's name, and accompanied by a guaranty. The analysis fully equaled and quite often exceeded the guaranty. Of the sixty-one samples collected, eleven were not guaranteed, and eight of these were decidedly inferior, containing 23 to 27 per cent of protein. They were put out by a Boston jobbing house, and were sold by retailers at the price asked for prime meal. *Farmers are strongly advised to purchase only guaranteed meals.*

Some of the linseed meals are now branded and guaranteed. Of the twenty-four samples collected, only one appeared to be at all inferior.

Gluten meals and feeds. The Chicago gluten meal was quite even in composition, exceeded the guaranty in protein, and contained a higher percentage than other brands of a similar nature. Many samples of Cream gluten meal fell below the guaranty. It is understood, however, that the protein percentage of this meal is likely to be increased.

The King gluten meal varied in its protein content from 29 to 38 per cent, probably due to differences in the milling processes at the several plants. The manufacturers should endeavor to produce a more even product.

Practically all of the gluten feeds sold in Massachusetts are made by the Glucose Sugar Refining Company, the National Starch Manufacturing Company, and the United States Sugar Refining Company. *They are among the most desirable and cheapest feed-stuffs in the market.*

Germ oil meal is the pulverized germ of the Indian corn, or ground corn cake. It is a desirable feed, but not quite as safe as the gluten feeds, because of the large amount of oil present. It is frequently advertised as "oil meal" and referred to as a substitute for cottonseed and linseed meals. *It is, however, a very different product, and the comparison is an unfair one.*

Wheat offal. By wheat offal is meant the various by-products from the flour mills—bran, middlings and mixed feed. Wheat bran and middlings show no adulteration; the variations observed especially in case of the middlings are probably due to the milling process and to the quality of the wheat. The fine light colored middlings containing 19 per cent or over of protein, are worth several dollars more per ton than wheat bran. Colonial middlings, so called, contained an admixture of hominy chop; the manufacturers do not claim them to be pure wheat middlings. Their cost per ton should be less by several dollars than the genuine article.

Mixed feed consists of the entire wheat offal, or varying mixtures of wheat bran, middlings and red dog flour. This feed is widely distributed, has a large sale, and most of it is entirely free from any foreign admixture. Unscrupulous parties are beginning, however, to adulterate with material similar to fine ground corn cobs, and a number of samples have been found only testing between 11 and 14 per cent of protein, and containing nearly twice as much fiber as the genuine article. In some cases they were simply marked mixed feed, while in two instances they had special brands, namely, Kentucky and Purity. The adulteration of this class of feeds is a serious matter, and deserves the earnest consideration of all honorable manufacturers and jobbers. The best way out of the difficulty is to brand or tag the product with the name of the manufacturer or jobber, together with a minimum guaranty of 16 per cent protein and 4.5 per cent fat. The simple mark of "mixed feed" is not a sufficient protection or guaranty either to the manufacturer or farmer, and reform in this particular is urgently advised.

II. Starchy Feeds.

Oat feed. This material, as is well known, consists of the refuse from mills engaged in preparation of oat meal for human consumption. A considerable portion of it is very inferior, and the particular attention of the reader is called to the analyses on page 17. A digestion experiment recently carried out with an inferior oat feed containing about 5 per cent of protein and 25 per cent of fiber,* showed it to contain only

*The larger the amount of fiber feeds contain, the less the nutritive value.

34 pounds to the hundred of digestible or actual food material. A few of these feeds containing approximately 8 to 10 per cent of protein, have about three-fourths the value of corn meal, while the larger number *have not over one-half the feeding value. It is believed that farmers actually throw away a large amount of money on this class of feeds.* Certain it is that with the variety of excellent feed-stuffs now on the market, much better and decidedly more economical grain rations can be obtained for the animals of the farm than is to be found in material of this character.

Quaker dairy feed is one of the better grades of oat feeds, mixed with some material high in protein. It was quite even in composition and is certainly superior to the average oat feed.

Corn and oat feeds, Provenders, etc. Most of these feeds consisted of mixtures of oat offal and corn meal. A few mixtures consisted in all probability of pure ground oats and corn. Mixtures of pure oats and corn should contain at least 10 per cent of protein and 4 per cent of fat.

Miscellaneous feeds. The sample of rye feed examined was worth approximately the price asked for it, namely, $21.00 in November, 1900. Corn bran is likely to prove an expensive feed at market prices. Parson's Six-Dollar feed is more useful as an absorbent than for feeding purposes.

Poultry feeds. The American and H. O. poultry feeds are mixtures of cereals such as corn, oats and wheat, with a small quantity of a nitrogenous feed stuff. These feeds are relatively expensive. The meat and bone meals varied from 30 to 50 per cent in protein. Those containing the highest amount of protein are the most valuable. They should be sold on a guaranty of protein and fat.

E. THE BEST FEEDS AND THE BEST RATIONS.

Frequent inquiry is made of the Station concerning the best concentrated feeds and the best feed combinations, particularly for dairy animals. There is no such thing as a best feed or ration for animals; there are, however, some that are more desirable and more economical than others.

Why concentrated feeds are fed.

Most of the home grown coarse feeds are high in carbohydrates, low in protein, and comparatively indigestible. Nearly all of the concentrated feeds are very digestible and a large number are high in protein, and low to medium in carbohydrates. The concentrated feeds are fed with the home grown coarse feeds therefore *first to increase the digestible matter; and second, to increase the amount of protein in the daily ration.*

Economical feeds.

Among the most economical concentrated feeds high in protein may be mentioned cottonseed meal, corn gluten meal, gluten feed, dried brewers grains, malt sprouts, and fine flour middlings with 18 to 20 per cent of protein.

Expensive feeds.

Wheat bran and mixed feed contain only 13 per cent of digestible protein, and 35 to 40 per cent of indigestible matter. The long distance transportation of substances containing such a large amount of inert material, is an important factor in making the nutrients they contain relatively expensive. While they are safe to feed and are most excellent for diluting or "lightening up" the more concentrated by-products, it is believed that farmers often feed them in excess to their pecuniary disadvantage. For milkmen they often furnish a partial and cheap substitute for hay, when the latter is expensive. The above remarks apply to New England conditions, as these products are undoubtedly among the very cheapest feeds for Western farmers. Linseed meal while a desirable milk producing feed, is as a rule an expensive one. It is not economical for the average farmer to *purchase* corn meal for milk production; it should be grown upon the farm. Milk producers who are obliged to purchase all of their feed, can on the contrary often feed grain mixtures containing one-third corn or hominy meal to advantage. Among other expensive concentrates may be mentioned oat feeds, and the various mixtures containing considerable quantities of oat offal. For obvious reasons it is generally decidedly more economical for farmer to make their own mixtures.

DESIRABLE GRAIN MIXTURES.‡

I.

100 lbs. cottonseed or gluten meal.*
125 lbs. flour middlings.
100 lbs. wheat bran or mixed feed.
Mix and feed six to seven quarts daily.

II.

250 lbs. gluten feed.
100 lbs. wheat bran or mixed feed.
Mix and feed eight quarts daily.

III.

5 to 6 quarts gluten feed daily scattered on the ensilage.

IV.

100 lbs fine middlings.
100 lbs. brewer's grain or malt sprouts.
Mix and feed 6 to 8 quarts daily.

V.

100 lbs. cottonseed or gluten meal.
150 lbs. corn or hominy meal.
100 lbs. wheat bran or mixed feed.
Mix and feed 6 to 7 quarts daily.

VI.†

100 lbs. gluten feed.
100 lbs. wheat bran or mixed feed.
Mix and feed 4 to 6 quarts daily.

VII.†

100 lbs. gluten feed.
100 lbs. hominy feed.
Mix and feed 4 quarts daily.

---

*Or linseed meal if not too expensive.
†For summer feeding to help our pastures.
‡For milk production.

F. KEY TO COMPARATIVE VALUES OF CONCENTRATED FEEDS.

Protein feeds.	Cottonseed meal,	152
	Cleveland flax meal,	134
	O. P. linseed meal,	138
	Gluten meal,	140
	Gluten feed,	121
	Wheat middlings,	107–114†
	Mixed feed,	90–95*
	Wheat bran,	86
	Malt sprouts,	95
	Dried brewer's grains,	100
	H. O. dairy feed,	96
Starchy (carbohydrate) feeds.	Corn meal,	100
	Hominy meal,	105
	Ground oats,	90
	Oat feed, (best grades),	70
	Oat feed, (excessive hulls),	40-50
	Quaker dairy feed,	84
	Corn and oat feed.	90
	Corn, oat and barley feed,	92*
	H. O. horse feed,	90

*Estimated but not actually determined.

†Fine light colored middlings with 18 to 20 per cent protein.

How to Use the Key.

It is not possible in this connection to show the relative *effects* of the various feed-stuffs on the flow of milk or the production of beef. The figures are offered rather as a key to the comparative commercial values of the different feeds based on the digestible nutrients contained in them. Thus if wheat bran is worth 86, cottonseed meal would be worth 152. These figures can be easily converted into dollars. Thus if corn meal is worth $20.00 per ton or 100, wheat bran would be worth 86 per cent of $20.00 or $17.20 the amount the farmer can afford to pay for the bran. Again with cottonseed meal worth $25, what can the farmer afford to pay for old process linseed meal? Cottonseed meal equals 152, or $25, and linseed meal 138. We have a case in simple proportion. 152 : 138 : : $25 : x=$22.70, the value of a ton of linseed meal. It must not be forgotten that these figures do not take into consideration the mechanical condition, or the particularly favorable effect which some feeds are supposed to exert upon the general health of the animal.

CONDIMENTAL STOCK AND POULTRY FOODS.

A. Introductory statement.
B. Tables of analyses.
C. Brands and manufacturers.
D. Discussion of the results.
E. Utility of condimental foods and condition powders.

A. INTRODUCTORY STATEMENT.

During the past few years the station has endeavored to make a complete collection of all the condimental stock and poultry foods sold in Massachusetts. The object has been first, to ascertain the amount of actual food material contained in them (protein, fat, starchy matter, etc.) as well as the nature of the substances furnishing the several nutrients; second, to observe so far as possible the general character of the other ingredients; third, to note the claims made by the manufacturers concerning their value; and fourth to note their cost in the open market. In the tables which follow this information is presented in as concise a form as possible. It is possible that all of these articles are not on the market at present. It appears that most materials of this character are sold for a short period because of the particular efforts and claims of the makers, and then the demand for them ceases. A few articles are extensively and continuously advertised, and are quite generally distributed.

Condimenta

Station number.	Brand.	FOOD ANALYSES. Water. %	Protein. %	Fat.* %	Extract matter.† %	Fiber. %	Ash. %	Principal ingredients of the article.
—	Corn meal.	14.00	9.50	3.30	70.40	1.80	1.40	}
—	Wheat bran.	11.00	16.10	4.50	52.20	9.80	6.80	} *For comparison.*
—	Linseed meal.	10.00	36.10	6.60	33.60	7.80	6.20	}
577	McClaren's.	11.05	10.38	3.35	67.96	1.43	5.83	Cereals. . . .
580	Champion.	10.10	12.75	4.53	68.36	3.62	10.64	Corn. . . .
586	Knight's vegtable.	8.59	15.25	4.53	51.47	7.47	12.69	Wheat offal. . .
591	Matthew's.	10.88	15.38	5.03	54.39	3.34	10.98	Cereals. . . .
592	Pratt's.	9.33	15.38	6.89	56.47	6.64	5.29	Cereals and bean. .
2208	Pratt's animal regulator.	9.11	10.13	4.56	61.86	3.33	11.01	Corn. . . . .
593	Climax.	10.19	10.03	18.91	41.06	4.71	15.10	Cereals. . . .
594	Thornley's.	10.55	19.19	5.81	44.73	9.80	9.92	Rice and linseed. .
595	Baum's	9.87	25.91	6.62	34.64	17.05	5.91	Linseed meal. . .
596	American spiced.	10.40	12.81	3.91	67.70	2.90	2.28	Corn. . . .
1489	Blatchford's. calf meal.	8.59	24.41	4.68	52.95	4.55	4.82	Linseed meal. . .
2205	Barwell's.	7.52	20.72	9.72	50.47	5.16	6.41	Linseed meal[s]. . .
1492	International.	9.09	16.97	9.35	48.22	8.63	7.74	Wheat offal. . .
1493	American triumph.	10.94	14.94	5.00	53.21	8.96	6.95	Cereals and cellular matte
1495	Meyer's spice.	11.47	15.03	4.29	52.86	6.09	10.26	Cereals. . . .
2207	Meyer's spice.	9.76	19.13	4.78	52.00	5 61	8.72	Corn and lentil. . .
1497	Colonial.	10.66	11.10	3.08	58.67	8.91	7.58	Uncertain. . .
1499	Nutriotone.	9.84	19.41	5.03	47.65	5.22	12.85	Uncertain. . .
1500	Triplex.	10.82	16.06	3.01	55.59	6.17	8.35	Bran. . . .
1501	White's.	10.21	15.81	5.42	52.33	10.44	5.79	Bran. . . .
2202	Banner.	8.88	23.56	4.96	38.01	15.24	9.35	Linseed meal. . .
2110	Dr. Hess's.	7.82	16.19	3.25	52.55	7.11	13.08	Bran. . . . .

ALYSES.

k Foods.

Other ingredients identified.	Cost per pound cents.‡
Condiment[1] corn, oats, wheat, rice.	—
Salt, sulfates[4], charcoal, linseed, rice.	—
Salt, Condiment[2], charcoal, rye, corn.	.07
Salt, linseed meal.	—
Condiment[3],	—
Salt, condiment,[1-2-3] sulfates.[4]	.25
Salt, sulfate of iron, wheat and barley.	—
Condiment[2], salt, bean.	—
Sulfate magnesia,[5] charcoal, linseed husks.	.09
Pepper.	—
Condiment[2], cereals, hemp, locust bean and sugar, latter possibly from locust bean.	.03
Uncertain.	.06
Salt, pepper, charcoal, material rich in protein.	.16
Condiment,[2] charcoal, corn, barley, material high in protein.	.10
Salt, corn, oats, rice, bean and linseed meals.	.10
Salt, condiment[2], linseed meal.	—
Condiment,[2] salt, large amount of charcoal, wheat.	.10
Salt, charcoal, bean, linseed, corn.	.16
Salt, iron,[6] bean, oats.	.06
Condiment.[2]	.06
Sulfates,[4] salt, charcoal, wheat offal, oats.	—
Condiment,[2] salt, charcoal, iron[4], sulfates[4], and material high in protein.	.07

Condi

Station number.	Brand.	FOOD ANALYSES. Water. %	Protein. %	Fat.* %	Extract matter.† %	Fiber. %	Ash. %	Principal ingredients of the article.
2909	Sheridan's.	6.54	16.50	15.53	29.22	15.85	16.36	Uncertain. . .
597	Sheridan's.	8.61	15.50	12.96	32.01	14.28	16.64	Uncertain. . .
585	Jersey.	11.41	14.07	3.19	52.04	7.31	11.98	Uncertain. . .
599	Stanley's.	9.35	13.13	4.32	61.91	5.83	5.46	Cereals. . .
602	Weston's.	9.31	15.63	4.70	59.27	5.00	5.09	——— . .

Pou

168	Eureka egg.	5.98	16.50	4.61	44.34[10]	7.78	20.79	Uncertain. . .
578	Eggine.	.73	3.06	1.94	20.75[10]	14.78	58.74	Carbonate of lime[7].
579	Prolific.	8.39	20.19	6.55	31.67[10]	9.21	23.99	Uncertain. . .
581	Flagg's.	8.34	13.97	3.78	58.92	5.85	9.14	——— . .
582	International.	9.03	15.75	4.46	54.19	11.87	4.70	——— . .
583	Anglo American.	7.99	16.06	5.33	56.59	8.70	5.33	Bran. . . .
584	Pratts.	8.88	15.32	8.59	54.31	5.94	6.96	——— . .
1922	Pratts.	9 15	14.16	5.63	57.52	6.68	6.86	Wheat offal. .
587	Dow's meal.	20.22	30.50	2.02	—	2.06	36.75	Meat and bone. .
589	Rusts.	4.56	19.31	3.53	13.57	6.52	52.51	Shells and charcoal.
598	Triplex egg.	5.68	18.31	3.63	27.68[10]	5.98	38.72	Wheat offal and shell
600	Knight's.	7.27	14.69	3.72	44.29	7.21	22.82	Bran. . . .
601	Ideal egg.	8.02	18.50	4.82	45.49	9.19	13.98	Cereals. . .
1491	Hess's panacea.	9.42	11.19	1.40	54.07	5.09	18.83	Uncertain. . .
2211	Hess's panacea.	8.27	11.81	1.88	41.18	4.32	32.50	Bran. . . .
1494	American triumph.	9.14	15.22	5.56	54.76	9.79	5.54	Cereals. . .
1496	Meyers' spice.	10.40	14.81	4.48	57.69	6.34	6.28	Corn. . . .
1498	Colonial	9.71	10.00	2.78	65.82	4.84	6.85	Cereals and charcoa
2199	Banner.	8.78	19.94	6.50	41.12	12.37	11.29	Linseed meal and wheat offal. .

*Ether extract. †Starchy matter. ‡Prices usually for small packages. Larger quanti somewhat less. 1. Bitter condiment resembling gentian. 2. Aromatic resembling fenugre 3. Aromatic resembling fennel. 4. Probably as Glauber's salts. 5. Probably as Epsom sa

ders.

	Other ingredients identified.	Cost per pound‡ (cents.)
)	Sulfate magnesia[5], carbonate and phosphate lime, charcoal, cellular matter, pepper, ginger, linseed.	1.00
'	ditto.	1.00
;	Sulfates,[4] iron,[6] pepper, ground herbs, wheat offal.	.18
)	Condiment[2], salt, corn, wheat.	.06
:	Condiment,[2] bean, wheat, corn and linseed meals.	.16

ds.

3	Salt, oyster shells, charcoal, cereals, and material high in protein.	—
3	Salfate of magnesia,[5] charcoal, pepper, animal matter.	—
9	Salt, sulfate of magnesia,[5] carbonate and phosphate of lime, sand, charcoal, animal matter, and linseed husks.	—
1	Salt, sulfate magnesia,[5] charcoal, pepper, iron,[6] wheat offal, corn.	.12
2	Charcoal, pepper, iron,[6] wheat, corn and material high in protein.	—
3	Charcoal, pepper, wheat and rye bran, corn and material rich in protein.	—
4	Iron,[6] pepper, condiment[2], bean, corn and rice meals.	.12
2	Condiment,[1] iron,[6] pepper and buckwheat.	—
7	Salt, oyster shells, meat and bone.	.15
9	Pepper, material high in protein.	.25
8	Sulfates,[4] iron, pepper. corn and material high in protein.	.12
0	Salt, condiment,[3] sand, corn, material rich in protein.	.10
1	Sulfates,[4] pepper, carbonate lime, iron, charcoal, and material high in protein.	—
1	Salt, sulfate magnesia,[3] iron,[6] carbonate of lime, barley.	.15
1	Salt, sulfates[4], iron[6], pepper, oyster shells, phosphate lime, barley.	.15
4	Condiment,[2] pepper, rye, barley, corn and material rich in protein.	.10
6	Salt, pepper, linseed. rape seeds.	.15
8	Salt and pepper. Barley most prominent grain.	—
9	Salt, charcoal, phosphate lime.	.10

Apparently as Venetian red. 7. Similar to fine ground oyster shells. 8. Perhaps some flaxed meal. 10. Of uncertain value, because of carbonic acid from shells.

C. BRANDS AND MANUFACTURERS.

Station number.	Brand.	Manufacturer.
577	McClaren's English horse food.	McClaren, Brockton, Mass.
580	Champion horse and cattle food.	Champion Food Co.
586	Knight's English vegetable food.	Knight's Stock and Poultry Food Co.
600	Knight's poultry food.	" " " "
591	Matthew's compound food.	Eastman Bros., Framingham, Mass.
592	Pratt's horse and cattle food.	Pratt Food Co., Philadelphia, Pa.
2208	Pratt's animal regulator.	" " " "
584	Pratt's poultry food.	" " " "
593	Climax stock food.	L. B. Lord, Burlington, Vt.
579	Prolific poultry food.	" " " "
594	Thornley's horse and cattle food.	Thornley Food Co., Chicago, Ill.
1499	Nutriotone.	" " "
595	Baum's stock food.	Baum Casterine Co., Syracuse, N. Y.
596	American spiced food.	American Spiced Food Co., Boston.
1489	Blatchford's calf meal.	J. W. Barwell, Waukegan, Ill.
2205	Barwell's horse and cattle food.	" " " "
1492	International stock food.	International Food Co., Minneapolis.
582	International poultry food.	" " "
1493	Amer. triumph horse and cattle food.	McKenzie & Winslow, Fall River.
1494	American triumph poultry food.	" " " "
1495	Meyer's royal spice for horses, cattle.	Meyer's, Niagara Falls, N. Y.
1496	Meyer's royal spice for poultry.	" " " "
1497	Colonial stock food.	Puritan M'f'g Co., Rochester, N. Y.
1498	Colonial poultry food	" " " "
1500	Triplex horse and cattle food.	Triplex Food Co., New Brunswick, N. J.
598	Triplex poultry food.	" " " " "
1501	White's stock food.	White Food Co., Taunton, Mass.
2202	Banner stock food.	Banner Food Co., Auburn, N. Y.
2199	Banner poultry food.	" " " " "
2210	Dr. Hess's stock food.	Dr. Hess & Clark, Ashland, Ohio.
1491	Dr. Hess's poultry panacea.	" " " "
597	Sheridan's condition powder.	I. S. Johnson & Co., Boston, Mass.
2209	Sheridan's condition powder.	" " " " "
585	Jersey tonic and condition powder.	H. A. Esterbrook, Fitchburg, Mass.
599	Stanley's condition powder.	J. J. Stanley, Lawrence, Mass.
602	Weston's condition powder.	J. W. Weston, New York, N. Y.
168	Eureka egg food.	Jos. Breck Sons Corp., Boston, Mass.
578	Eggine.	Eggine Co., Hartford, Conn.
581	Flagg's poultry food.	
583	Anglo-American poultry food.	Anglo-American M'f'g Co., Boston,
587	Dow's poultry meal.	J. C. Dow, Boston, Mass.
589	Rust's egg producer.	Wm. Rust & Sons, New Bruns'k, N. J.
601	Ideal egg food.	Poultry Supply Co., Boston, Mass.

D. DISCUSSION OF THE RESULTS.

It is not claimed that the number of ingredients identified in the above foods is in all cases complete, for being composed of a number different materials, one is likely to cover up another, and it is occasionally difficult to positively identify each single ingredient. It is believed, however, that the examination is sufficiently complete to give a correct idea of the general character of such foods.

Character of the food materials. All of the condimental foods have a distinct nutritive value and consist principally of one or more of the cereals, such as corn, wheat, wheat offal, or barley. In many cases a few hundred pounds to the ton of linseed, cottonseed, corn gluten meal, and occasionally meat scraps, have been added to increase the amount of protein. Such mixtures contain from 10 to 20 per cent of protein. A few contain a considerable quantity of linseed meal, together with smaller quantities of cereals, and show 20 to 25 per cent of protein. The ash contained in the poultry foods is often much in excess of the quantity found in the stock foods. This is due to the presence of fine ground oyster shells.

Value of the food materials. The nutrients contained in the different condimental foods *can be purchased* in the form of corn meal, wheat offal and linseed or cottonseed meal for one cent a pound or twenty dollars a ton. The average *cost* of the condimental foods on the other hand varied from six to eighteen cents a pound, or $120 to $360 a ton. Condition powders are much higher in price; one brand costs fifty cents to one dollar a pound, depending on the quantity purchased.

Character of the other ingredients. *Salt*, from 2 to 10 per cent in amount, is found in most of the condimental feeds.

Fenugreek and fennel. They are the ground seeds of Trigonella Foenum-Graecum, and Foeniculum vulgare, grown in Southern Europe. They are aromatic substances and stomachics, being used in veterinary medicine to relieve indigestion and flatulence, and also to communicate an agreeable flavor. It was formerly believed that fenugreek increased the quantity and improved the quality of milk, but such ideas are now largely exploded. Fenugreek costs about 25 cents a pound and fennel 50 cents a pound at retail. The wholesale price is much less. The quantity used is comparatively small.

Gentian, occasionally recognized, is the dried root of the plant known as Gentiana lutia and is grown in Central and Southern Europe. It is very bitter and is used as a stomachic and tonic, promoting an increased secretion of the gastric juice. It costs about 25 cents per pound at retail.

Ginger, is the powdered underground stem of Zingiber officinale, grown principally in India and the West Indies. It stimulates the various membranes with which it comes in contact. It is used as a stomachic, and to reduce the griping effects of purgatives.

Sulfates of magnesia and soda, in the form of Epsom and Glaubers salts, are used as purgatives, and cost 5 cents per pound at retail. They are frequently spoken of as "salts."

Pepper. The common black pepper, chiefly used in veterinary practice, is obtained from the brown berries of an East India climbing plant, the Piper nigrum. The cayenne pepper consists of the dried ripe fruit of Capsicum fastigiatum and annuum. Both varieties have been recognized, especially in the poultry foods and condition powders. Pepper is used as a stomachic and also to increase the activity of the reproductive organs.

Sulphur, recognized occasionally, is employed as a laxative, and as a stimulant of the mucus surfaces.

Iron, found as Venetian red (in which form it is not used medicinally), is apparently employed to color or disguise the real character of the food. Sulfate of iron, used as a restorative and tonic, was seldom identified.

Charcoal. Its medicinal value consists in its ability to check fermentative changes, and to absorb undesirable gasses. In some cases it appears to have been ground fine with the other ingredients to conceal their identity.

To summarize, the condimental foods are composed principally of the various common grains together with small quantities of fenugreek, gentian, pepper, and charcoal, to act as tonics, increase the appetite, and relieve indigestion; and Epsom or Glaubers salts to increase the activity of the bowels.

Value of the other ingredients.

Such materials as fenugreek, gentian, ordinary salt, Epsom salts, charcoal, ginger, and pepper are unquestionably valuable as simple medicines when properly used. It is certain, however, that they can be obtained *very much cheaper* when purchased sepa-

rately than when mixed with such bulky materials as wheat bran or linseed meal. If an animal is actually in need of a purgative or a stomach tonic, is it not economy to purchase a pound of Epsom salts for five cents or a pound of gentian for twenty-five cents rather than pay three dollars for twenty pounds of some mixture in order to secure the desired medicines? It is not believed that medicines are needed in order to promote egg production, but rather warm, well ventilated, sunny houses, plenty of exercise, and in addition to the ordinary grains a liberal allowance of meat scraps and green vegetables. Is it not cheaper for the poultry raiser to buy salt, oyster shells, charcoal and meat scraps by themselves rather than pay ten or twenty cents a pound for them in the form of a "celebrated" poultry food?

The writer does not believe in giving medicine to animals unless there is positive evidence that it is needed. Well animals are better off without it, and sick ones should be treated for the specific trouble with which they are affected, or consigned to the shambles.*

Manufacturers' claims. If one will read the circulars issued by many manufacturers he will be surprised at the claims made for these foods. It is stated that they will prevent and cure diseases, promote perfect digestion and assimilation, induce rapid growth, and fattening, increase the quantity and improve the quality of the milk, cause a large increase in egg production, and make beautiful plumage. The following is quoted from a circular: "This superior medicated food removes all taints of disease from milk, and makes it a more perfect food; it will increase the supply of rich milk, keep the hair smooth, the skin healthy" etc. To accomplish this and other wonderful things the circular states "the average feed (for each cow) is one and one-fourth pounds a month (or two-thirds ounce each day)". Such a food was composed principally of wheat offal, a small quantity of cottonseed meal, and some salt, pepper and charcoal. It is unnecessary to dwell further upon the ridiculous character of these claims. "For the promoters of such mixtures to claim that they have any knowledge of compounds and compounding not common to veterinary medicine, is charlatanism in its most offensive form."

*If it seems evident that a general tonic is needed Bartlett recommends the following: Pulverized gentian, one pound; pulverized ginger, one-fourth pound; pulverized saltpetre, one-fourth pound; pulverized iron sulfate, one-half pound. Mix and give one tablespoonful in the feed once a day for ten days, omit for three days, then give ten days more. Cost of the above twenty cents a pound.

What experiments have taught.

Hills* fed Nutriotone to seven cows in accordance with the instructions of the circular. He states "the material does not appear to have increased productiveness in this particular experiment."

Bartlett† made a similar trial of the value of Nutriotone using five Jersey cows. He states that "Nutriotone was taken in preference to any other compound, not because it is believed to be any better or worse than any other of a like nature, but for the reason that it is being extensively advertised and persistently sold by the Company's agents not only as a curative agent, but as a stimulant of the production of flesh and milk."

His conclusion is as follows: "In neither of these cases did nutriotone seem to have any effect favorable or unfavorable. The slightly smaller flow with nutriotone does not mean anything in particular, except to add increased emphasis to the falseness of the claim that two large tablespoonfuls fed with each feed "will produce a great increase of much richer milk'".

Brooks‡ fed Sheridan's condition powders to poultry in three experiments and states that he obtained no noticeable increase in egg production and that the powders did not pay for their use.

Sir John Lawes‡‡ instituted experiments with a condimental food using six pigs and twenty sheep to determine its effect on growth and fattening. He concludes the description of his experiments as follows:

"It is clear that nothing was gained by adding to the barley-meal and bran, one-fifth of its weight of food, costing about five times as much money." "The results previously published of experiments with pigs, taken together with those now recorded in regard to sheep, seem sufficiently conclusive against the assumption that the use of the so-called condiments increases the assimilation of food, by fattening animals in a state of health. They are equally conclusive on the subject of the profit or loss to the feeder from the use of such substances." "In conclusion, I feel bound to say, that I should require much clearer evidence than any that has hitherto been adduced, to satisfy me that the balance-sheet of my farm would present a more satisfactory result at the end of the year, were I to give each horse, ox, sheep, and pig, a daily allowance of one of these costly foods."

*Eighth annual report of Vermont Experiment Station, page 150.

†Twelfth report of the Maine Experiment Station, pages 51-55.

‡Cited by Paige.

‡‡Journal of the Royal Agricultural Society, Vol. 19, 1859. Rothamsted Memoirs, Vol. II. 1886.

E. THE UTILITY OF CONDIMENTAL FOODS AND CONDITION POWDERS.

By Dr. James B. Paige.

A study of the action of patent foods, condition powders and tonic foods can best be made by a study of the action which the essential constituents of such foods have upon the various tissues of the body when ingested. While none of the foods are identical in composition, all contain one or more substances to which their specific action is due. Ordinarily the active ingredient is mixed with various grains and by-products in order to increase the bulk of the mixture, and in certain instances to disguise its disagreeable taste or odor.

Condiments and tonics, what they are, and how they act.

As a rule the specific substance found in such foods belongs to one of the following classes of drugs: *condiments*, *tonics* or *alteratives*.

Condiments are defined as pungent appetizing substances used for flavoring foods; they excite the appetite and promote digestion.

Tonics are substances which increase the strength or tone of the animal system, obviating the effects of debility and restoring healthy functions. They are classified according to the particular organ or tissue they act upon, as blood, vascular, gastric, intestinal and nerve tonics.

Blood tonics improve the quality of the blood; vascular tonics increase the flow of blood to a part, improving cell activity and nutrition; nerve tonics strengthen and restore tone to the weakened nerve tissue; gastric and intestinal tonics increase the appetite and aid digestion.

The action of these various tonics is quite complex. Some act directly upon a tissue to increase its functional activity, while others produce the same effect by an indirect action through the circulation, or by an action upon the nerves which regulate the functional activity of a particular organ, or a part of it. To illustrate: The secretion of gastric juice may be increased by the direct action of an alkali upon the mucous membrane of the stomach, or the same result may be obtained by the administration of a drug which will increase the flow of blood to the mucous membrane of that organ.

Alteratives are substances which improve the general nutrition of the body without exerting a special action on any particular organ. Their action is more general than that of tonics; they are of value in combating disease of a constitutional nature, accompanied by general mal-nutrition, due to impared tissue activity or to a retention of waste products in the body

Some of the more common drugs that are benefiicial as condiments, tonics, and alteratives are: iron sulphate, arsenic, potassium iodide, sulphur, gentian, ginger, caraway, anise, cardamon, fennel, fenugreek and pepper.

Having briefly considered the general action of condiments, tonics, and alteratives, one naturally asks:

First. Are such substances beneficial to animals in a healthy condition, either for improving their condition, or for stimulating the production of meat, milk, and eggs?

Second. Are tonic foods or condition powders of value for sick animals?

Third. What effect follows their long continued use?

Effect of condiments and tonics on healthy animals.

Contrary to the popular belief, animals, in a state of health, under favorable conditions as regards food and stabling, *do not need condition powders or tonic foods*. There is in the body of such an animal a condition of equilibrium of all body functions. The processes of nutrition, digestion, and assimilation are at their best. All that is required to maintain this condition of balance is that the animal be kept under sanitary conditions and receive a sufficient quantity of healthful, nutritious food, and pure water. It may be possible by the use of such substances to improve the appetite so that an animal will ingest and possibly digest more food, but should the increased quantity of nutrient constituents elaborated, not be appropriated by the tissues of the body, *harm may result from the overloading of the lymphatic system, or from an increased activity of the excretory organs.*

Stimulating foods may have a greater influence upon egg production than upon meat or milk production.

It is unquestionably possible to stimulate and excite the reproductive system by the use of drugs. As a result of this stimulation the organs become more vascular and active, in consequence of which

there may be a development that will lead to an earlier egg production. Admitting that it is thus possible to promote earlier laying, has it yet been demonstrated that the *total product* of a fowl can be increased by such methods?

Brooks' three experiments on the use of condition powder with poultry bear upon this point. He states: "A study of the figures shows that the hens not getting the condition powder laid more eggs, of practically the same average weight. The food required to produce a single egg was less, and the cost was very materially less. *In the light of these results, it is believed that poultry keepers throw away money expended for condition powder.*" (Eleventh report Hatch experiment station, page 90.)

Effect of condiments and tonics on diseased animals.

In the case of sick animals there are abnormal conditions to be taken into consideration, such as loss of appetite, weakened digestion, poor circulation, and mal-nutrition. Until every organ performs its normal function a state of health does not, cannot exist. If by the administration of a tonic, stimulant or an alterative, it is possible to restore to a normal condition any organ so that it can perform its function, then every organ in the body is benefited.

Foods act similarly to drugs in this respect. Take for example a horse that has been fed for six months upon hay and grain and allow him green food for a time, or feed in the place of the accustomed ration of oats a more stimulating grain, and as a result ridges of horn soon appear upon the hoofs (due to the increased nutrition of the horn secreting band of the foot).

The results of long-continued use.

The results of long continued use of condiments and tonics depend somewhat upon the amount administered and the condition of the animal to which they are given. A stimulant or tonic action upon an organ is followed by a reaction characterized by weakness and depression of the function of that particular part. For illustration, the use of moderate quantities of a gastric stimulant improves the appetite and assists digestion, but when the quantity is increased above a certain amount, or the use of the drug continued beyond a certain time, the effect is to produce a congestion and inflammation of the stomach, a condition which is unfavorable for the digestion of food.

Yeo* remarks concerning condimental foods, "Many of these, by conferring agreeable flavors and by their warm carminative properties promote appetite and assist digestion; but their excessive use is calculated to excite irritation and disorder of the digestive organs."

When to use condimental foods.

In the great majority of cases where tonic foods or condition powders appear to be necessary, *they can be dispensed with and usually to the advantage of the animal.* Any real or apparent diseased condition that can be cured by the administration of an indiscriminate mixture of drugs *can ordinarily be relieved with less danger to the patient by the adoption of a rational system of treatment and feeding.*

In those instances where drugs are necessary, it is far better *to employ one or more, adapted to the treatment of the particular ailment,* than to attempt a cure by the administration of a "shot-gun" mixture, in the form of a patent food or condition powder.

In the end such specific treatment is infinitely less expensive, less dangerous and more satisfactory.

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*Food in Health and Disease.

HATCH EXPERIMENT STATION

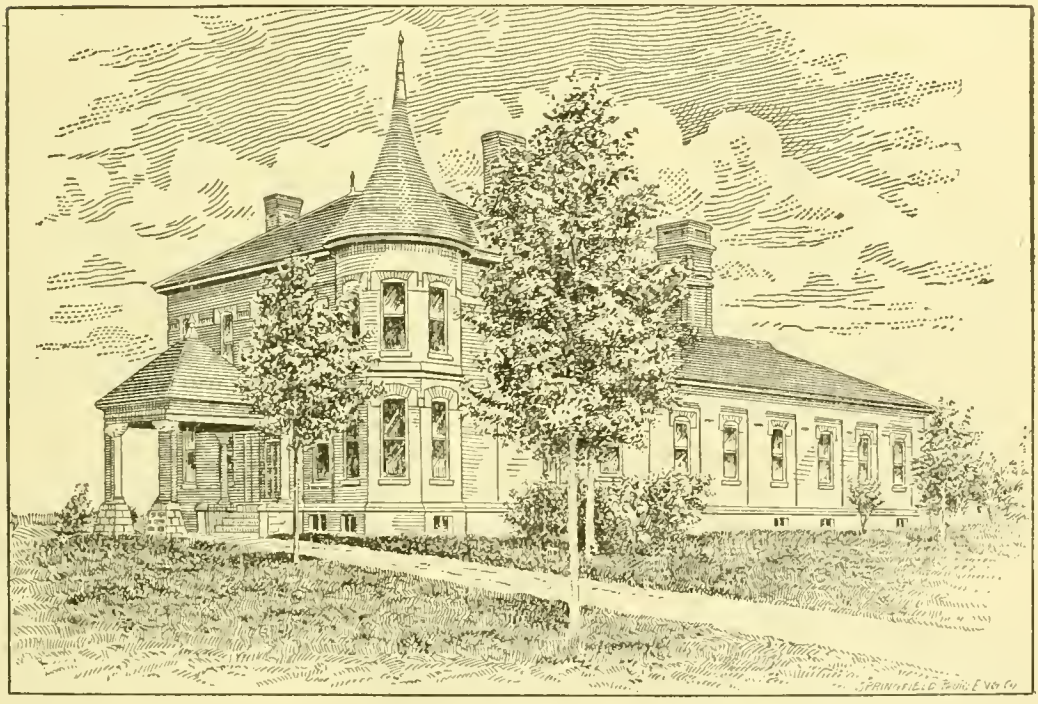
—OF THE—

MASSACHUSETTS

AGRICULTURAL COLLEGE.

BULLETIN NO. 72.

SUMMER FORAGE CROPS.



CHEMICAL LABORATORY.

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1901.

HATCH EXPERIMENT STATION

OF THE

Massachusetts Agricultural College,

AMHERST, MASS.

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The co-operation and assistance of farmers, fruit-growers, horticulturists, and all interested, directly or indirectly, in agriculture, are earnestly requested. The Bulletins will be sent free to all newspapers in the State and to such individuals interested in farming as may request the same. General bulletins, fertilizer analyses, analyses of feed-stuffs, and annual reports are published. Kindly indicate in application which of these are desired. Communications may be addressed to the

HATCH EXPERIMENT STATION, Amherst, Mass.

DIVISION OF FOODS AND FEEDING.

JOSEPH B. LINDSEY.*

SUMMER FORAGE CROPS.

A. Pasturage and pasture grass.
B. Desirable forage crops.
C. Fertilizers for forage crops.
D. Feeding forage crops for milk production.
E. Composition and digestibility of forage crops.

In this bulletin it is intended to present a concise description of those forage crops which are believed to be the most nutritious, economical and best suited to the needs of Massachusetts farmers. All of the fodders and fodder mixtures herein described have been grown upon the grounds of the station and fed to the station herd. They have been frequently analyzed, and in most cases their digestible ingredients determined.

A. PASTURAGE AND PASTURE GRASS.

It is believed that whenever possible dairy animals should be pastured during five months of the year. The open air, continuous sunlight, and exercise resulting, are certainly most desirable and beneficial after the long confinement of the late autumn and winter months. The change from dry feed to the succulent grasses and herbs is likewise advantageous and acts as a tonic to the entire animal system.

Why pasture grass is superior to most forage crops.

One reason why pasture grass is superior to the cereal fodders and grasses is that it contains pound for pound more protein, the numerical relation of the protein to the carbohydrates (nutritive ratio) being as 1 to 5. If the cereal fodders and grasses were cut when two or three inches high they would have fully as much or even more protein than the mixed pasture herbage,

*Assisted by E. B. HOLLAND and P. H. SMITH, JR.

but as they continue in growth the carbohydrates are developed to a greater extent than the protein, until when full and late bloom are reached the relation of the protein to the carbohydrates is as 1 : 7 or 1 : 12. The clovers and clover-like plants on the other hand contain, if cut in bloom, fully as much protein as the pasture herbage.* Again pasture grass contains less woody fiber than the coarser fodders of the cultivated fields and is consequently more tender. It probably has a more desirable flavor as the animals seem to prefer it to the fodders and grasses nearer maturity. In addition to the superiority of pasture grass, the system of pasturage when practicable, is the most economical way of caring for and feeding the dairy herd.

Summer soiling a substitute for pasturage.

Unfortunately many pastures, owing to neglect and continuous cropping have become quite inferior, and dairy animals depending upon them for their food supply, are often obliged to travel over large areas, and even then do not secure sufficient food to keep in good flesh and to maintain the flow of milk. The droughts so likely to occur during the summer months often render it necessary—if the herd is to be kept in a profitable condition—to furnish additional food, even should the pasture be considered good. Again some dairymen do not have sufficient pasturage, while others in the vicinity of large towns have little or none. When therefore pasturage is not obtainable, or only to a limited extent, it becomes necessary to supply other fodder material to take its place, and a system of entire or partial soiling results.

B. DESIRABLE FORAGE CROPS.

Non-legumes and legumes.

Forage crops may be divided into two classes, non-legumes and legumes. Botanically these two classes have many distinct characteristics. It is simply necessary to state in this connection, that the legumes are distinguished from the non-legumes by having the so-called "butterfly flowers," by being able to take nitrogen from the air, and by containing at the same stage of growth, considerably more pro-

*When forage crops take the place of pasture grass, it is desirable that mixtures of the clovers and similar plants be grown together with the grains and grasses, in order to secure more protein than is to be found in the latter. Such mixtures usually contain 1 protein to 6 or 7 carbohydrates. (1 : 6 or 7.)

tein than the non-legumes. Among the most important non-leguminous forage plants may be mentioned wheat, rye, barley, oats, corn, millet, and the grasses usually grown for hay. The most desirable legumes are vetches, peas, soy beans and clovers. The vetch closely resembles the pea in its habit of growth and general appearance; it has, however, finer stems and leaves. There are two species used for fodder purposes, the spring vetch (Vicia sativa), and the winter or sand vetch (Vicia villosa). The vetches and peas are chiefly useful for green forage, to be grown together with the cereal fodders. The latter plants furnish a desirable support.

There are several varieties of soy beans, but the *medium green* variety is to be preferred. Its chief value is as a green forage crop. Farmers using these legumes for fodder purposes can if they desire grow their own seed.

Order to be followed in the description.

In describing the various fodders and fodder mixtures, those available in the late spring will be first mentioned, and the description will then continue of those best suited for the summer and autumn months. Following the general description, a table will be found in which an attempt has been made to bring together in concise form the most important data, such as time of sowing, seed to the acre, area to be sown, etc.

Wheat and winter (sand) vetch.

This mixture of a non-legume and a legume promises to be a very desirable spring green fodder. It has been planted for two years, and a third planting looked exceedingly well last autumn. The first planting—made in the late summer of 1898—winter killed, owing in all probability to the fact that the seed was sown too early (August 1). The second year, 1899, the seeding took place August 25, and an excellent yield was secured the following spring. One and one-half bushels of wheat and one bushel of vetch were sown to the acre at one sowing, and covered with a wheel harrow. Cutting was begun May 31 just before the wheat began to head. The vetch began to blossom June 5. The yield was at the rate of 10 tons of green fodder to the acre, and cutting was continued for twelve days. The spring of 1900 was fully 10 days backward, and the rainfall quite deficient. Had the weather been as warm as usual and the precipitation normal, cutting would have begun earlier. If more of the fodder mixture has been produced than can be fed green the balance may be made into hay. The cost of the vetch seed is

very high this season ($5.50 to $7.00 a bushel) due to the fact that in those sections where the seed is grown, the drought was severe last year, and the crop was largely fed green. The usual price is one-third less. The vetch develops an abundance of root nodules, and must fix large quantities of atmospheric nitrogen. It has been found to be very digestible, and animals eat it freely.

Wheat itself when sown in early September at the rate of two bushels to the acre also makes a satisfactory spring green feed and is considered preferable to rye. If however it can be grown together with a leguminous crop, the nutritive value of the fodder mixture is decidedly enhanced. Land from which wheat or wheat and vetch have been removed can be immediately sown to corn, corn and beans or Hungarian grass.

Grass and clover or clover.

The green crop naturally following the wheat and vetch is either a mixture of grass and clover or clover itself. The grasses should be of the earlier varieties blooming in early June. The following mixture costs about five dollars and is intended for one acre : alsike* or red clover, 8 pounds ; tall oat grass, 8 pounds ; orchard grass, 6 pounds ; Kentucky blue grass, 6 pounds. The seed should be sown in early August if possible, in order to enable the clover to become well established before winter. The yield will be from 6 to 8 tons to the acre, and cutting can usually begin as the first blossoms appear, generally about June 7. Two-thirds of an acre would be ample for 10 cows ten days. If it appears that more has been grown than can be fed green, the balance can be made into excellent hay. If allowed to stand until long past bloom, the mixture becomes tough and less digestible. A second cutting of several tons to the acre can be obtained if the rainfall is sufficient. Land thus seeded can be cropped for two successive years.

Clover would probably be preferred by many to the grass and clover, for the reason that the 15 or 20 pounds of seed necessary to the acre can be obtained for one-half the price of the grass and clover mixture. The first cutting can be made nearly as early as the grass and clover, and the yield will be as large. A second and occasionally a third cutting can be secured. Clover is a great nitrogen gatherer and is very nutritious.

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*The writer rather prefers the alsike clover because of the finer stem.

Oats and peas. Oats and Canada field peas make the best green crop to follow clover. Generally it is advisable to make three sowings: the first as early as possible in the spring, April 20 to 25, and the second and third fifteen and thirty days later. One and one-half bushels each of the oats and peas is the usual quantity to the acre. They may both be sown broadcast at the same time after the land is plowed, and thoroughly harrowed in with a wheel harrow. Some sow the peas first, covering with a wheel harrow, then sow the oats and cover with an acme or similar harrow. This method however is hardly necessary. The first sowing will be ready about June 25 and cutting should begin as soon as the oats show the head. The average yield from the first sowing is 10 tons to the acre. The yield from the second and third sowings is not likely to be as heavy, as the crop matures more quickly during the warm weather. Oats and peas will remain in condition to be cut for 10 or 12 days. The average cow will consume 60 to 80 pounds daily until the feed becomes tough. One-third to one-half acre will furnish sufficient fodder for 10 cows twelve days.

Oats and Spring Vetch have also been grown quite successfully at the station. They are equally as digestible as the oats and peas, and will generally yield as heavily. Should the spring prove dry however the vetch is likely to make a poor growth, the oats taking the larger part of the available moisture. The vetch seed is also more costly than the peas.

Hungarian grass. Land from which the first cutting of oats and peas has been removed may be immediately seeded with Hungarian grass or may be used for barley and peas, or for clover. The Hungarian grass if seeded the first week in July will be ready to cut by September 10 to 15. It also makes a very satisfactory green feed for August, if sown early in June, but barnyard millet is preferred owing to the greater yield. The usual quantity of seed is one-half to one bushel to the acre.

Barnyard millet and peas. Barnyard millet (Panicum crus-galli) makes a desirable green feed for the first three weeks of August. This variety of millet is becoming quite generally known, and the seed can be purchased of the more prominent seedsmen. It is not in the writer's judgment as satisfactory a feed as corn, but it has its place among the desirable forage crops. The millet is a warm weather plant similar to corn. It will not stand

dry weather as well as the former, is a heavy feeder and will do best upon a warm moist soil. It makes a very rapid growth, when the temperature is high. If sown by itself, 14 quarts of seed are sufficient for one acre; when combined with peas eight quarts of millet and one and one-half bushels of peas are the quantities required. The first seeding may be made together with peas May 10 to 15. The peas should first be sown and harrowed in deeply and the millet covered more lightly with an acme or other harrow. Should the weather prove cool during the latter part of May and early June the peas will grow more rapidly than the millet, but with the advent of a few warm days the latter will rapidly overcome the disadvantage. A second and even a third seeding of millet may be made (without peas) at intervals of 20 and 15 days respectively. The millet and peas will be ready to cut about August 1 and the other two sowings will follow, so that green feed may be secured from this crop during all of August if desired. Cutting should begin even before the millet begins to head and can be continued for 10 or 12 days. When the millet is well headed it becomes tough and animals are likely to refuse a considerable portion of the stems. Millet does not make a satisfactory hay because of the difficulty in drying.

Corn and Soy beans.

A mixture of corn and soy beans is a most desirable fodder crop for the last ten days of August and the first two or three weeks in September. A medium early corn is preferred. Some of the sweet varieties are excellent. The Canada or Longfellow are also desirable. The medium green soy bean is the most suitable variety. This Japanese bean is now so well known that a description is hardly necessary. The seed can be purchased of all large dealers. It grows 3 to $3\frac{1}{2}$ feet high, needs no support, and is thickly studded with leaves. For several years we have sown the corn with an Eclipse corn planter in rows $3\frac{1}{2}$ feet apart, and then planted the beans with a hand corn planter in the same rows with the corn, one lot of beans being placed every few inches. An experiment has convinced us, however, that it is preferable to mix the corn and beans together in the proportion of about 10 quarts of corn to 7 quarts of beans. This mixture can be planted with an Eclipse or other planter. The planter should be regulated so that the kernels will be about two inches apart in the row. It will of course be impossible to maintain

WHEAT AND WINTER VETCH.

Yield 10 tons to the acre.

OATS AND PEAS.

Yield 10 tons to the acre.

BARNYARD MILLET.

Yield 12 to 16 tons to the acre.

CORN AND SOY BEANS.

Yield 12 tons to the acre.

this regularity, but it will be sufficient for the purpose. The crop is to be cultivated and harvested in the same manner as corn. The first seeding should be made May 15 and a second June 5. One-half acre is ample for 10 cows two weeks. The first sowing will be ready to cut about August 20 and the second the first week in September. When cutting begins the corn will have many well formed ears, and the beans will have begun to form seed. The yield to the acre will be in the vicinity of 12 tons, equal to $2\frac{3}{4}$ tons of dry matter containing 3600 pounds of actual digestible material. If corn is grown extensively upon the farm one planting of corn and beans may be sufficient, the farmer preferring to feed from his field corn after the first week in September.

Fodder corn without the beans also makes an excellent green feed.

Soy beans may be grown by themselves in rows $2\frac{1}{2}$ feet apart. The usual quantity of seed required for an acre is 16 quarts, which may be sown with a corn planter so regulated as to place the seed one inch apart in the row. The crop is cultivated in the same manner as corn. The writer is however inclined to prefer the *corn and bean mixture* for forage purposes.*

A small power cutter is a great convenience on any farm. Such crops as barnyard millet, corn, and corn and beans, are eaten clean if cut fine, while if fed without cutting, the animals are likely to leave the coarser portions as soon as they become tough.

Barley and peas.

Barley and peas furnish a satisfactory green crop during the first three weeks of October; they are not injured by frosts. One and one-half bushels each to the acre are sown together the first of August and deeply harrowed in with a wheel harrow. The yield will not be as large as in the case of the oats and peas, six tons to the acre being about an average crop. The land from which the oats and peas were taken earlier in the season can be utilized, thus producing two crops in one year, equivalent to four tons of hay to the acre. Should the month of August prove unusually dry, this crop might prove a failure espec-

*Corn and soy beans also make a very satisfactory ensilage. When they are grown separately, however, the extra expense involved in cutting and putting the beans into the silo exceeds the value of the increased amount of protein obtained. It is also questionable whether the corn and beans if grown together could be handled with sufficient economy to warrant their use for silage purposes. The experiment is however worthy of trial.

ially on light soils. We have generally been successful with it on medium loams. Farmers in the vicinity of the sea coast state that they have not succeeded in growing peas late in the season owing to the dampness of the atmosphere due to the numerous fogs. Barley may be grown by itself if it would thrive under such conditions. Some farmers thus located have grown cabbage as a late fodder crop. It seems to the writer that the crop might prove expensive for this purpose, owing especially to the labor involved in caring for it. Cabbage is also a heavy feeder.

Summer Forage Crops.

(Data for ten cows entire soiling.)*

Kind.	Seed for an acre.	Approx. time of seeding.	Area.	Approximate time of cutting.
Wheat and winter vetch.	1 1-2 bushs. wheat. 1 bushs. vetch.	Sept. 1.	1-2 acre.	May 25 to June 8.
Wheat.**	2 bushs.	Sept. 1.	1-2 acre.	May 25 to June 8.
Grass mixture and clover.	8 lbs. clover. 8 lbs. tall oat grass. 6 lbs. orchard grass. 6 lbs. Kentucky blue.	August.	2-3 acre.	June 10 to June 25.
Clover.†	15-20 lbs.	August.	2-3 acre.	June 10 to June 25.
Oats and peas.	1 1-2 bushs. each.	April 20.	1-2 acre.	June 25 to July 6.
" "	" "	May 5.	1-2 acre.	July 6 to July 17.
" "	" "	May 20.	1-2 acre.	July 17 to July 28.
Millet and peas.	8 qts. millet. 1 1-2 bushs. peas.	May 15.	1-3 acre.	Aug. 1 to Aug. 10.
Millet.‡	14 qts.	June 5.	1-3 acre.	Aug. 10 to Aug. 20.
Corn and soy beans.	10 qts. corn. 7 qts. beans.	May 15.	1-2 acre.	Aug. 20 to Sept. 4.
Corn and soy beans.	10 qts. corn. 7 qts. beans.	June 5.	1-2 acre.	Sept. 4 to Sept. 20.
Barley and peas.	1 1-2 bushs. each.	July 25 to Aug. 1.	2-3 acre.	Oct. 5 to Oct. 20.

*It is understood that the time of seeding, area to be seeded, and yield to the acre, will be governed somewhat by the weather conditions, and the fertility of the soil.

**Instead of wheat and vetch, if vetch is too expensive.

†In place of grass and clover if desired.

‡Leave out peas in this sowing.

Cost of various seeds.

Variety.	Approximate cost a bushel.	Pounds to the bushel.
Canada field peas,	$1.50	60
Winter vetch,	$4.00	60
Spring vetch,	$2.50-$3.50	60
Medium green soy beans,	$4.00	58
Winter wheat,	$1.75	60
Barnyard millet,	$2.75-$3.00	35
Tall oat grass,	$2.50	12
Orchard grass,	$2.50	14
Kentucky blue grass,	$1.75-$2.00	14

The peas, beans and spring vetch can be obtained of any New England seed house. The winter vetch is at present offered only by New York seedsmen.

Objections to summer soiling.

The chief objection to the growing of summer forage crops is the time and labor consumed in their production. It becomes necessary to prepare numerous small pieces of land at frequent intervals and to cut and draw small quantities of fodder to the barn every two or three days. Work of this character is time consuming and frequently interferes with more extended farm operations. For this reason some farmers prefer to supplement pasturage with hay and grain, believing it to be more economical. No definite rules can be laid down concerning the most suitable method to follow. It is certainly desirable that animals should receive at least a portion of their daily ration in the form of green feed during the growing season. Each farmer must study his own conditions and follow the system best adapted to his particular needs.

The summer silo.

Corn ensilage is quite often used as a substitute for pasture grass and green forage, especially in those sections where frequent and long continued droughts are prevalent. The silo should be so constructed as to render a less surface area of silage exposed than during the winter months.

The writer does not favor silage as a summer feed whenever other forage can be economically supplied. The corn as is well known, undergoes fermentation in the silo, and among other products, a considerable amount of acetic acid is formed. It is this acid which renders the ensilage sour, and it is decidedly objectionable as a food ingredient, especially if fed continuously. It is therefore preferable from the standpoint of health, to supply the animals during the summer, with freshly grown green forage, and leave the fermented

material for the long period during which other more desirable green feed is not to be obtained.

C. FERTILIZERS FOR FORAGE CROPS.

Because of the considerable amount of labor involved in the production of soiling crops and the shortness of the growing periods, they should be supplied liberally with plant food, and thus be made to produce maximum yields. It is decidedly poor economy to attempt to grow such crops in poor unfertilized soils. Intensive rather than extensive culture should be the motto of the producer.

Barnyard manure and chemicals.

Six cords of barnyard manure may be considered a reasonable application to the acre. Frequently when the supply is limited it is convenient to apply three or four cords to the acre and supplement with commercial fertilizers. In such cases the following mixture is suggested:

Nitrate of soda,	100 pounds,
Acid phosphate,	100 pounds,
Muriate of potash,	100 pounds.

In the case of wheat and vetch, grass and clover, or clover, sown in August or September, it is advisable to apply the barnyard manure at the time of seeding, and top dress in the early spring with the fertilizer mixture. If clover is grown by itself use only 50 pounds of nitrate of soda. Clover-sick land is very much benefited by the additional application of 1000 pounds of slaked lime to the acre. If refuse lime from the lime kilns can not be procured the ordinary barrel lime may be used. It should first be placed in small piles in the field and allowed to slake, before spreading.

Chemical fertilizers exclusively.

When it is desired to grow forage crops with the aid of chemical fertilizers exclusively, the following mixtures will be found suitable for land in a fair state of fertility. If the soil is poor the quantity may be increased one-third. The figures refer to the quantities required for one acre.

I. For wheat and vetch, grass and clover, and clover to be applied at the time of seeding.

Nitrate of soda,	50 pounds.
Acid phosphate,	300 pounds.
Muriate of potash,	200 pounds.

Top dress in the spring with 100 pounds nitrate of soda.

In case of clover use 50 pounds nitrate of soda for the spring top dressing.

II. For oats and peas, and barley and peas.

Nitrate of soda,*	200 pounds.
Acid phosphate,	300 pounds.
Muriate of potash,	150 ponnds.

III. For millet and peas, and corn and beans.**

Nitrate of soda,*	200 pounds.
Acid phosphate,	300 pounds.
Muriate of potash,	200 pounds.

The fertilizers may in all cases be sown broadcast and harrowed in.

D. FEEDING FORAGE CROPS FOR MILK PRODUCTION.

When forage crops are grown to supplement pastures the feeding of a reasonable amount at night is quite satisfactory. If the pasturage is very deficient another feeding in the morning may be made, or the morning feed may consist of a few quarts of grain as follows:

I.

2 quarts of gluten feed.

II.

100 pounds gluten feed.
100 pounds wheat bran or mixed feed.
Mix and feed 2 to 4 quarts.

III.

100 pounds gluten feed.
100 pounds hominy meal.
Mix and feed 2 to 3 quarts.

Should summer soiling be practiced exclusively, five pounds of hay may be fed daily together with what green material the animals will eat. This usually amounts to about 60 to 80 pounds a day. An exception is made to this method in case of clover and millet. It is not wise to feed over 50 pounds of these latter crops for the reason that more clover is likely to cause bloating, and an excess of millet acts as a laxative and diuretic. While animals will consume as high as 80 pounds of millet for the first few days an abnormal looseness of the bowels quite frequently develops, and they are inclined to refuse over 50 or 60 pounds daily thereafter. In those cases therefore 10 pounds of hay are fed daily together with 50 pounds of the green crops. It is generally economy in order to

*Should the soil be light and leach easily, one-half of the nitrate of soda may be replaced by 200 pounds of dry ground fish, or cottonseed meal.

**Should millet and corn be grown without the peas and beans, it would be advisable to add 150 pounds of dry ground fish, especially if the land is light.

maintain the flow of milk to feed some grain in connection with the coarse fodders and the following mixtures will be found desirable.

I.

3 to 4 quarts of gluten feed daily.

II.

100 pounds gluten meal.
200 pounds fine middlings.
125 pounds wheat bran.
Mix and feed 4 to 5 quarts daily.

III.

150 pounds gluten feed.
75 pounds wheat bran.
Mix and feed 4 to 5 quarts daily.

IV.

100 pounds fine middlings.
150 pounds dried brewers grains or malt sprouts.
Mix and feed 4 to 5 quarts daily.

When 50 pounds of clover are fed daily the quantity of these mixtures may be diminished about one-third.

E. COMPOSITION AND DIGESTIBILITY OF FORAGE CROPS.

The following table is divided into two parts: one headed *composition*, represents the total percentages or pounds in 100 of the different ingredients contained in the various fodders, and the other headed *digestibility*, shows the percentage or pounds in 100 *actually digestible*. The table is made up partly from the analyses and digestion work carried out at this station and partly from other sources.* In many cases the analyses and digestion tests are too few in number to secure any very satisfactory averages. Single samples of different fodders show quite noticeable variations in composition and digestibility, depending on weather conditions, fertility of soil, and stage of growth.

The average analyses of the several *groups* as presented in the table, give a more correct idea of the probable composition of the cereal fodders, legumes and fodder mixtures, than does the analysis of a single fodder in the group. The same holds true concerning digestibility.

The table shows as much digestible protein in the cereal fodders as in the fodder mixtures, the latter being a combination of a cereal fodder and a legume. This is due primarily to the difference in the amount of water present. The fodder mixtures naturally contain more protein than the cereal fodders.

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*Vermont Experiment Station Bulletin 81, and Bulletins Nos. 11 and 77, Office of Experiment Stations.

Table I. Figures equal percentages, or pounds in 100.

Kind.	Number of Analyses.	Composition. Water.	Ash.	Protein.	Fiber.	Nitrogen free extr't	Fat.	Digestibility. Dry matter	Protein.	Fiber.	Nitrogen free extr't	Fat.	Nutritive ratio.
I. Non legumes.													
(a) Pasture grass, ...	..	80.0	2.0	3.5	4.0	9.7	0.8	13.8	2.3	3.0	7.0	.40	1 : 4.8
(b) Cereal fodders,													
Rye fodder,†	7	76.6	1.8	2.6	11.6	6.8	0 6	14.7	1.9	6.6	4.6	0.4	1 : 6.4
Barley fodder,.....	6	75.2	2.0	3.4	6.5	12.0	0 9	16.4	2.4	4.0	8 5	0.5	1 : 5.7
Oat fodder, ...	4	75.0	1.7	2.3	8.4	11.8	0.8	15.0	1.7	4.4	7 4	0.6	1 : 8.0
Average, ...	..	**75.4**	**1.8**	**2.8**	**8.8**	**10.1**	**0.8**	**15.2**	**2.0**	**5.0**	**6.8**	**0.5**	**1 : 6.7**
(c) Millets,													
Barnyard millet, ...	4	80.0	1.8	1.8	6.9	9.2	0.3	14.2	1.2	5 0	6.6	0.2	1 : 10.7
Hungarian grass, ...	2	74.0	2.1	2 6	7.0	13.8	0 5	17.4	1.7	5.0	9.4	0.3	1 : 8.9
Average, ...	..	**77.0**	**1.9**	**2.2**	**7.0**	**11.5**	**0.4**	**15.8**	**1.5**	**5.0**	**8.0**	**0.3**	**1 : 9.5**
(d) Corn,													
Fodder corn,*	40	79.8	1.1	2.0	4.3	12.1	0.7	13.7	1.2	2.6	9.0	0.5	1 : 10.7
Sweet fodder corn, ...	21	79.1	1.3	1.9	4.4	12.8	0.5	14.8	1.2	2.8	9.9	0.4	1 : 11.4
Average, ...	..	**79.5**	**1.2**	**1.9**	**4.4**	**12.5**	**0.6**	**14.3**	**1.2**	**2.7**	**9.5**	**0.5**	**1 : 11.1**
(e) Grasses,													
Orchard grass,**.....	4	73.	2.0	2.6	8.2	13.3	0.9	..	..	..	..	..	..
Tall oat grass,**.....	3	69.5	2.0	2.4	9.4	15.8	0.9	..	..	..	..	..	..
Kentucky Blue Grass,**	5	69.1	2.4	3.2	8.3	16.1	0.9	..	..	..	..	..	..
Timothy,**.....	14	65.1	2.0	2.8	10.4	18 7	1.0	22 3	1.3	5.8	12.3	0.5	1 : 14.9
Red Top,**‡.....	5	64.8	2.3	3.3	9.4	19.1	1 2	22.5	1.6	5.3	12.6	0.6	1 : 12.1
Average, ...		**68.3**	**2.1**	**2.9**	**9.2**	**16.6**	**1.0**	**22.4**	**1.5**	**5.6**	**12.5**	**0.6**	**1 : 13.5**
II. Legumes.													
Canada peas, ...	1	76.0	1.9	3.9	7.0	10.6	.6	..	..	..	..	..	..
Soy beans,††	14	76.0	2.5	4.2	6.5	9.7	1.1	14.4	3.2	3.1	7.1	0.6	1 : 3.7
Red Clover,‡‡	43	70.8	2.1	4.4	8.1	13 5	1.1	19.3	2.9	4.3	10.5	0.7	1 : 5.7
Alsike clover,**.....	4	74.8	2.0	3.9	7.4	11.0	0.9	16.6	2.6	3.9	8.6	0.6	1 : 5.4
Winter vetch, ...	2	80.9	1.8	4.4	5.6	6.5	0.8	13.4	3.7	3.4	4.9	0.6	1 : 2.6
Spring vetch,.....	1	78.2	1.7	4.4	5.7	9.5	0.5	..	..	..	..	..	..
Spring vetch, ...	2	82.0	1.5	2.7	5.5	7.9	0.4	..	..	..	..	..	..
Average both, ...	3	80.1	1.6	3.5	5.6	8.7	0.5	12.4	2.5	2 5	6.6	0.3	1 : 4.
Average, ...	..	**77.4**	**1.9**	**4.0**	**6.5**	**9.8**	**.8**	**15.2**	**3.0**	**3.4**	**7.5**	**0.6**	**1 : 3.8**
III. Fodder mixtures.													
Wheat and winter vetch,	1	80.0	1 2	2.5	6.8	9.0	.5	13.4	1.9	4.6	6.1	.2	1 : 6.
Orchard grass and clover,	1	80 0	1.5	2.4	6.5	9.0	.6	13.0	1.4	3 6	6.5	.4	1 : 8.1
Tall oat grass and clover,	2	80 0	1.5	2.7	5.8	9.5	.5	13.0	1.6	3.2	6 9	.3	1 : 6.5
Oats and peas, ...	9	80.0	1.6	3.3	5.6	8.6	.9	13.0	2.5	3.4	5.8	.6	1 : 4.3
Oats and vetch, ...	3	80.0	1.8	2.9	6.3	8.3	.7	13.4	2.2	4.3	5.7	.3	1 : 4.9
Millet and peas, ...	1	80.0	1.8	2.4	7.5	8.0	.3	13 0	1.8	4.5	5.4	.2	1 : 5.7
Corn and soy beans,.....	1	80 0	1.3	2.8	4.3	11.2	.4	12.8	1.9	2.3	8.3	.3	1 : 6.
Barley and peas, ...	9	80.0	1.8	3.6	5.0	8.8	.8	13.0	2.9	2.5	5.9	.5	1 : 3.3
Average, ...	..	**80.0**	**1.6**	**2.8**	**6.0**	**9.0**	**.6**	**13.1**	**2.0**	**3.5**	**6.3**	**.4**	**1 : 5.6**

* Flint varieties.
** In bloom.
† Digestion coefficients an average of those for oats and barley.
‡ Digestion coefficients those for Timothy.
†† Variety uncertain.
‡‡ All analyses.

Table II. Pounds of *digestible* dry matter, protein, and carbohydrates (the latter including fat x 2.50) in *different weights* of the several *fodder groups*.

Pounds of Fodder.	Dry Matter.	Protein.	Carbohydrates.	Dry Matter.	Protein.	Carbohydrates.	Dry Matter.	Protein.	Carbohydrates.
	Pasture Grass, 1:4.8.			Cereal Fodders, 1:6.7.			Millets, 1:9.8.		
10	1.40	0.2	1.1	1.50	0.2	1.3	1.6	0.2	1.4
25	3.50	0.6	3.0	3.80	0.5	3.3	3.9	0.4	3.5
50	6.90	1.2	6 0	7.60	1.0	6.6	7.9	0.8	6.9
60	8.30	1.4	6.6	9.10	1.2	7.9	9.5	0.9	8.3
75	10.40	1.7	8.0	11.40	1.5	9.8	11.9	1.1	10.4
100	13.80	2.3	11.0	15.20	2.0	13.1	15.8	1.5	13.8
	Corn Fodder, 1:11.1			Grasses, 1:13.5.			Legumes, 1:3.8.		
10	1.40	0.1	1.4	2.2	0.2	2.0	1 5	0.3	1.2
25	3.60	0.3	3.4	5.6	0.4	4.9	3.8	0.8	3.1
50	7.20	0.6	6.8	11.2	0.8	9.8	7.6	1.5	6.2
60	8.60	0.7	8.1	13.4	0.9	11.8	9.1	1.8	7.4
75	10.70	0.9	10.1	16.8	1.1	14.7	11.4	2.3	9.3
100	14.30	1.3	13.5	22.4	1.5	19.6	15.2	3.0	12.4
	Fodder Mixtures, 1:5.6.								
10	1.3	.2	1.1						
25	3.3	.5	2.7						
50	6.6	1.0	5.4						
60	7.9	1.2	6.5						
75	9.8	1.5	8.1						
100	13.1	2.0	10.8						

CORRECTION.

On page 20, Bulletin No. 71 of the Hatch Experiment Station, it is stated that the sample of *Raw Ground Bone* manufactured by C. A. Bartlett, Worcester, Mass., is vegetable ivory. This statement is incorrect. The material is as represented, *Genuine Bone of Excellent Quality*. The error, due to a clerical mistake in reporting the analytical results, was not observed until too late to be corrected in the Bulletin, and is much to be regretted.

J. B. Lindsey.

HATCH EXPERIMENT STATION

—OF THE—

MASSACHUSETTS

AGRICULTURAL COLLEGE.

BULLETIN NO. 73.

ORCHARD EXPERIMENTS.
FERTILIZERS FOR FRUITS.
THINNING FRUITS.
SPRAYING FRUITS.

MARCH, 1901.

AMHERST, MASS.:
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HATCH EXPERIMENT STATION

OF THE

Massachusetts Agricultural College,

AMHERST, MASS.

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The co-operation and assistance of farmers, fruit-growers, horticulturists, and all interested, directly or indirectly, in agriculture, are earnestly requested. The Bulletins will be sent free to all newspapers in the State and to such individuals interested in farming as may request the same. General bulletins, fertilizer analyses, analyses of feed-stuffs, and annual reports are published. Kindly indicate in application which of these are desired. Communications may be addressed to the

HATCH EXPERIMENT STATION, Amherst, Mass.

Horticultural Division.

S. T. Maynard and Geo. A. Drew.

ORCHARD EXPERIMENTS.

The Apple. In this year of abundance the apple crop in the station orchards was the largest in their history.

Orchard No. 1 of 32 trees planted 15 years ago has been kept under thorough cultivation during the whole time. The fertilizers used per tree were: In 1899, 2 lbs. fine dry fish, 2 lbs. sulphate potash, 1 lb. nitrate soda. In 1900, 25 lbs. Canada ashes and $1\frac{1}{4}$ lbs. nitrate soda. The aim in the use of fertilizers was to keep up a uniform growth of 6 to 12 inches, the fertilizers used varying according to the season and the crop produced. The trees with the exception of one or more checks were all sprayed according to the calendar on the last page. This orchard, like the others, containing only one tree of each variety, presents a somewhat uneven appearance. The varieties most conspicuous were the Wealthy, Washington Royal (Palmer Greening), Sutton Beauty and Lawyer. The last named variety yielded from a tree only 8 inches in diameter over 4 barrels of choice apples.

Orchard No. 2 of 57 trees is on rather dry, stony land with a hardpan subsoil, the trees having been planted some 15 and 20 years. Strips of land about 8 ft. wide between the rows were cultivated throughout the entire season, the grass growing along the line of the trees was cut twice during the season and allowed to lie on the ground without removal, serving as a mulch and a protection to the fruit falling to the ground. This orchard also consists of only one or two trees of a variety. The fertilizers used were the same for 1899 and 1900 as for Orchard No. 1. The most noticeable varieties were Gravenstein, Astrachan, Williams, Hurlbut, Ben Davis, Lady Apple, Fall Pippin, Wolf River, Baldwin and Fameuse. Nearly every tree bore a full crop, one Hurlbut, 10 inches in diameter, yielding over 6 barrels; one Lady Apple, 8 inches in diameter, 5 barrels, four barrels of which sold for $22; one Fameuse, 9 inches

in diameter, 4 barrels; one Baldwin, 10 inches in diameter, 4 barrels; one Red Russet, 1 foot in diameter, 5 barrels; etc.

Orchard No. 3 of 28 trees is on rather moist, stony land with hardpan subsoil and has not been cultivated for 15 years. The grass has been cut twice or more each season and left on the ground when cut, or raked under the trees. The same fertilizers were applied as to No. 1 and 2 and all the trees made a satisfactory growth. The noticeable varieties were Porter, King, Duchess, Pewaukee, Haas, Baldwin, Pound Sweet, Scarlet Cranberry and Westfield Seek-no-further, etc. One King, 10 inches in diameter, yielded 4 barrels; one Baldwin, 9 inches in diameter, 4½ barrels; one Pound Sweet, 3½ barrels; one Scarlet Cranberry, 4 barrels. The trees in all three orchards, except checks, were sprayed with the Bordeaux mixture and Paris green three times during the early part of the season, and those most subject to the scab were sprayed a short time before the fruit was gathered with a weak solution of copper sulfate, 3 ounces to 50 gallons of water. During very wet seasons two applications of this fungicide should be made, one the last of August and another before picking, to prevent the late growth of the scab which often continues if the apples are not kept very dry after being put into the cellar.

THINNING FRUIT.

Most of the fruit in the above orchards was thinned when about one inch in diameter, checks being left wherever necessary. Careful records were kept of the cost of thinning, and the value of the fruit on the thinned and unthinned trees was estimated as follows:

Variety.	Expense of Thinning.	Yield bbls.	Value.	Gain per tree.
Red Astrachan, unthinned,		4⅘	$3.00	
Red Astrachan, thinned,	$1.20	5	$5.05	$2.05
Early Harvest, unthinned,		1½	0	
Early Harvest, thinned,	.15	1½	.98	.98
Hurlbut, unthinned,		5	$3.00	
Hurlbut, thinned,	.45	5	$3.55	.55
Baldwin, unthinned,		3¼	$2.00	
Baldwin, thinned,	.60	4	$2.90	.90
R. I. Greening, unthinned,		2	$1.50	
R. I. Greening, thinned,	.15	2½	$2.10	.60

The entire crop of the orchards was sold about Sept. 1st for 75c. per barrel, the purchaser bringing barrels to the orchards, and the apples were picked, sorted, and put into his barrels without facing. This included all fall and early winter apples such as Porter, Hurlbut, Pewaukee, Fameuse, Mother, Pound Sweet, etc., etc. The Baldwins and late keeping varieties were sold in the same way for $1.00 per barrel.

The difference in length of time consumed in thinning the trees was due first to the varying size of the trees and second to the necessity of employing help unaccustomed to this particular work. With a large orchard and skilled labor the cost per tree would be largely reduced.

The growth of the trees in the above orchards was about the same under the varying conditions. In the lighter soils and in dry seasons the necessary amount of moisture was preserved by frequent cultivation of the entire surface, in the medium soils by the cultivation of strips between the trees, while in naturally moist soils no cultivation was needed. These results lead us to make the following observation. That on light land better results will be obtained by frequent and thorough cultivation, while on land well supplied with moisture cultivation is not as essential.

The fruit of the varieties most in demand was as follows: In the order of ripening, Astrachan, Oldenburg, Gravenstein, Wealthy, Fall Pippin, McIntosh, Hubbardston, Baldwin, Washington Royal, Sutton Beauty and Roxbury Russet. Some of the very late keeping varieties, ripening in May and June, especially valuable for late shipping, are the Ben Davis, Lawver, York Imperial, Scarlet Cranberry, Walbridge, Mann, etc., which supply a need not filled by the former list, but which should not be put into the market in competition with those varieties that are of better quality.

The Peach. About 40 varieties fruited the past season and the fruit was of unusual size and quality. Orchard No. 1, five years from planting, is growing on land where two previous generations of peach trees had been grown, the first lot having been planted in the spring of '70, the second lot in '84. The present planting was set in '96, the past season being the fifth year of growth. Two trees of each variety were planted and the land has been under constant cultivation since planting. The fertilizer used the past two years was as follows: In 1899, 1½ lbs. fine dry fish and 1 lb. sulfate potash per tree. In 1900, 7 lbs. Canada ashes and 1 lb. nitrate soda per tree.

The growth of wood on these trees was good, and the fruit matured was of large size and good quality. More fertilizer, however, will be needed the coming season to repair the waste of last and keep the trees in a vigorous, healthy condition, especially if a crop of fruit is produced, as is now promised. One tree of each variety was sprayed with the dilute Bordeaux mixture (4 lbs. copper sulfate, 4 lbs. caustic lime and 100 gallons water) three times for the peach scab, adding Arsenic Lime in the first two applications for the destruction of the plum curculio and other insects. The result of this spraying was very clearly indicated. The fruit on the unsprayed trees was in most cases seriously injured by the scab, and in some cases by the brown-rot or monilia, while on the sprayed trees little or no injury was done by these pests.

The varieties showing the greatest value were: Mountain Rose, St. John, Early Crawford, Old Mixon, Late Crawford, Champion and Elberta, and to this list may be added the Crosby and Dennis for home use.

At the present time (Mar. 1st) the fruit buds are found to be considerably injured, ranging from 90% upward in the Elberta and Early Crawford, to only 10 to 20% in the Crosby, Dennis, etc. Counting in all varieties, probably more than three-fourths of the fruit buds are destroyed.

Orchard No. 2, consisting of about 250 trees, was planted in 1898 between young apple trees that are set 40 ft. apart. The trees made an unusual growth and set a moderate crop of fruit, all but about a dozen specimens of which were removed while small. The land was thoroughly cultivated in 1899 with a crop of corn, but with no crop during the past season. The fertilizers used were: In 1899, $\frac{1}{2}$ lb. fine fish, $\frac{1}{4}$ lb. nitrate soda and 1 lb. sulfate potash per tree. In 1900, 7 lbs. Canada ashes, $\frac{1}{2}$ lb. nitrate soda per tree. In August, the land was sown with barley and Canada peas as a cover crop to prevent the land from washing during the fall and winter and to supply organic matter for the support of the trees. At the present time three-fourths of the buds are winter killed, but enough are uninjured to produce a large crop of fruit if nothing further happens to them.

The Plum. As was generally the case in all parts of the State, the plum crop was the largest and best in the history of the orchard, especially the varieties of European plums. The orchards contain a large number of varieties with only one or two trees

of each, ranging from one to thirty years old. The fertilizers used were: In 1899, from ¼ to 2 lbs. nitrate of soda, 1 to 3 lbs. fine dry fish and 1 to 2 lbs. sulfate of potash per tree. In 1900, 5 to 10 lbs. Canada ashes and 1 to 2 lbs. nitrate soda per tree.

Nearly all varieties fruited and among those most productive was one Lincoln, trunk 3½ inches in diameter and 8 years old, from which was gathered 3½ bushels that sold for $10.50; one Bradshaw, same diameter, yielded 3 bushels; one Kingston, 4 inches, 2 bushels; one Quackenbos, 5 inches, 3 bushels; one Washington, 5 inches, 2 bushels; one Burbank (Japanese), 4 inches, 3 bushels. The black knot has been prevented from injuring the trees by spraying according to the calendar, and the brown rot has been nearly controlled in the same way.

Japanese Plums. Nearly all the valuable varieties of this group of bearing size are growing in the station orchards, but the crop has been small owing to the injury to the fruit buds or trees during the winter, and some were unfruitful from other causes. While most of the older varieties are much inferior in quality to the best European varieties, they have compensating qualities. They come into bearing at from two to three years from planting. They bear heavy crops, and, even if not long lived, may prove profitable, because new orchards can be grown quickly to take the place of old or sickly trees. Of the older varieties the Abundance and Burbank are perhaps the best, with Wickson and October Purple of better quality, but of uncertain productiveness. The Hale has thus far proved unproductive.

The American Plums are now attracting much attention on account of their hardiness and freedom from injury by the plum curculio and the brown rot. In quality none of the pure natives have proved equal to the European or the best of the Japanese, but some of the new hybrids with the Japanese or the European are of fine quality and are very promising. Among the best of this group fruited are the Wild Goose, Hawkeye, Hammar, Gold or Golden, etc.

The Grape. This crop was large and of fine quality, little rot or mildew appearing, owing to the dry weather and thorough spraying. The fertilizers used were: In 1899, ½ lb. fine dry fish, ¼ lb. nitrate soda and ½ lb. sulfate potash per vine. In 1900, 3 lbs. ashes, ¼ lb. nitrate soda per vine. The only new variety that holds a place with the Concord, Worden and Green Mountain is Campbell's Early. This ripens with Moore's Early and has a rather hard, but sweet pulp, a tough skin, hangs long on the vine and keeps well in storage.

The Blackberry. An unusual crop was produced by nearly all varieties, affording ample opportunity to make comparative tests. Of the older varieties the

Agawam	yielded	at	the	rate	of	2067 quarts per acre.
Snyder	"	"	"	2300	"	"
Taylor	"	"	"	3267	"	"
Ohmer	"	"	"	3000	"	"
Eldorado	"	"	"	2178	"	"
*Mersereau	"	"	"	1000	"	"
*Rathbun	"	"	"	2284	"	"

Fertilizers used: In 1899, $\frac{3}{4}$ lb. fine dry fish, $\frac{1}{4}$ lb. nitrate soda, $\frac{1}{2}$ lb. sulfate potash per hill. In 1900, 5 lbs. ashes, $\frac{1}{4}$ lb. nitrate soda per hill. Hills planted 7x7 feet.

Raspberries. This crop was not so satisfactory as was that of the blackberry, the canes of many varieties having been winter killed. The fertilizers used were the same as for the blackberry and the plants were set the same distance apart. The Cuthbert and Loudon have given the best results, with the King as the best early variety. The first is liable to winter kill, the second is subject to mildew during the summer and requires a rather rich moist soil, but the fruit is large and of fine color and quality.

The Currant. Owing to extremely dry weather in June, this crop was not as large as usual, the berries being small. The fertilizers used were: In 1899, $\frac{1}{4}$ lb. fine dry fish, $\frac{1}{4}$ lb. nitrate soda, $\frac{1}{4}$ lb. sulfate potash per bush. In 1900, 3 lbs. Canada ashes, $\frac{1}{4}$ lb. nitrate soda per bush. The varieties yielding the most fruit were

Cherry	at	the	rate	of	6764	quarts per acre.
Fays	"	"	5206	"	"	

The Wilder, Red Cross and Pomona showed some fine fruit on bushes one or two years younger than the above. The Pomona is the best flavored red currant and White Imperial the best among the white kinds.

The Strawberry. The early blossoms of this crop were cut off by frost and the crop was somewhat reduced thereby, but the remaining fruit was of good size and sold for good prices. The land upon which the crop was grown was fitted by plowing under in the spring

*Rathbun and Mersereau 3d year. Eldorado and Ohmer 4th year. Agawam, Taylor and Snyder 7th year.

about 5 cords of stable manure, and then thoroughly harrowing in 1,000 lbs. of fertilizer composed of 667 lbs. fine dry fish and 333 lbs. sulfate of potash before the plants were set. Planting was done the last of April, and thorough cultivation was kept up until the freezing of the ground, in order to keep down the growth of the weed known as the mouse-ear chickweed, with which the land had become infested. The plants were trained in the wide distance matted row system, i. e. rows 3½ feet apart and plants from four to six inches apart covering beds about 2 feet wide. The six varieties that yielded the most fruit are as follows:

Sample	at the rate of		4625	quarts	per	acre.
Glen Mary	"	"	3562	"	"	"
Brandywine	"	"	3504	"	"	"
Haverland	"	"	3187	"	"	"
Clyde	"	"	3087	"	"	"
Ruby	"	"	2593	"	"	"

One hundred varieties were fruited in small plots, consisting of 26 varieties fruiting for the first time, and the balance of those that have fruited one or more years previously. The six new varieties that gave the best results *on light land** were Stone's Early, Standard, Howard's No. 4, Howard's No. 36, Fountain and Dr. Arp. *On heavy soil*, Howard's No. 4, Lehman's No. 2, Howard's No. 36, Watson, Dr. Arp and Stone's Early. The most noticeable varieties were Stone's Early which was very early, of medium size, good quality and the most productive, and Howard's No. 4 which was remarkable for size, beauty, quality and productiveness.

SPRAYING CROPS.

In growing all fruit and vegetable crops, insecticides and fungicides were used according to the calendar appended to this bulletin. Check trees or plants were left in all cases.

Insecticides. The main dependence for the destruction of leaf and fruit-eating insects has been upon Paris Green, with arsenate of lead and Arsenic Lime upon the peach, cherry and Japanese plum. Kerosene and soap solutions applied in a fine spray or mist or in water were used for aphides, scale and other insects that feed by sucking the juices of plants.

*The Sample in these plots was injured by standing water during the winter.

Fungicides. The principal fungicides used were the copper sulfate in the form of Bordeaux mixture and simple solution, i. e. 1 lb. copper sulfate to 25 gallons of water, but in a few cases a trial of other well-known combined insecticides and fungicides was made.

Bordeaux mixture. (Full strength.) The formula used for making this mixture has been, 4 lbs. copper sulfate, 4 lbs. caustic lime (fresh unslaked), 50 gallons of water. The formulas 4 lbs. copper sulfate, 5 lbs. caustic lime and 50 gallons of water or 5 lbs. copper sulfate, 5 lbs. caustic lime and 50 gallons of water are also largely used with satisfactory results. *Dilute Bordeaux* is made of 4 lbs. copper sulfate, 4 lbs. caustic lime and *100 gallons of water.*

Many reports come to us of difficulties in preparing and applying this mixture, which difficulty can be generally traced to the *imperfect slaking* of the lime or to the failure *to dilute* the lime mixture sufficiently before it is mixed with the copper sulfate solution. The lime should be slaked by applying a small quantity of water at a time, adding more only as fast as it is taken up by the lime, then when all the lime is slaked into a powder or thick paste add water until a very thin milk-like liquid is produced. At least five gallons of water to the 4 or 5 lbs. of lime is needed to make it pour and strain well when added to the copper solution, which should also be at least 5 gallons in quantity.

The *lime mixture should be strained through two thicknesses of coarse burlap or a fine mesh strainer* when it is added to the copper solution, and the *mixture strained* when poured into the pump-tank or barrel. *Very vigorous and continued stirring should be kept up during the mixing* of the lime and the copper solution.

Stock solution. While the freshly prepared Bordeaux mixture will always give the best results, stock solutions of 25 to 50 lbs. of each substance may be made when a large amount of spraying is to be done, but they *must not be put together until ready for spraying.*

Combined Insecticide and Fungicides. In almost all cases an insecticide was used with the Bordeaux, thus saving one-half of the labor of applying the two.

SPRAYING OF FRUITS.

*The Apple.** Upon fruiting trees Paris green was used at the rate of $\frac{1}{4}$ pound to 50 gallons of the Bordeaux mixture up to about July

*See Spraying Calendar.

1st. The solution of copper sulfate,3 ounces to 50 gallons of water, was applied toward the last of September. The season having been unfavorable for the growth of fungi, the fruit was unusually free from scab and the benefit from the use of fungicides was not so apparent, but marked results were obtained from the use of insecticides.

The Plum (European).* Marked results were obtained from the use of the Bordeaux mixture and Paris green in the prevention of the growth of the black knot and the rotting of the fruit. No shot-hole fungus has appeared for many years on trees that were sprayed. *(Japanese Plums and Cherries.)* In the spraying of these fruits the dilute Bordeaux mixture (4 lbs. copper sulfate, 4 lbs. caustic lime to 100 gallons of water) was used without injury to the foliage, while with the full strength Bordeaux the leaves were seriously injured. For the destruction of the plum curculio and other leaf-eating insects, in place of Paris green, which has proved so effectual upon the apples and European plum but which cannot be used on peach, cherry or Japanese plum, the arsenate of lead and Arsenic Lime were used, the former being preferred.

The Peach. In an orchard containing 42 varieties in their fifth year's growth, two trees of each variety,—one tree was sprayed with the dilute Bordeaux and arsenic lime $\frac{1}{4}$ lb. to 50 gallons, first as soon as the petals were fallen, second ten days later and about the middle of July with the dilute Bordeaux mixture alone for the peach scab,while the other was left unsprayed. The result of this spraying was very marked, the fruit on the sprayed trees being larger, of better color and nearly free from scab,and the foliage more perfect and of better color.

To test the value of several insecticides found in the market advertised not to injure the foliage of the peach, cherry and Japanese plum, the Clark orchard was divided into 9 plots. This orchard consists of 4 rows of Japanese plums, 88 trees ; 3 rows of European plums, 66 trees ; 1 row of American or native plums, 22 trees ; 4 rows of pears, 88 trees ; 1 row of cherries, 22 trees ; 14 rows of peaches and apples, 253 of the former and 77 of the latter. The plots are arranged across the rows and include all of the above kinds of fruit thus :

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*See Spraying Calendar.

Check unsprayed.	Bordeaux and Green Arsenoid.	Check unsprayed.	Bordeaux and Insect Green.	Check unsprayed.	Bordeaux and Arsenic Lime.	Check unsprayed.	Bordeaux and arsenate of lead.	Check unsprayed.
54 trees	81 trees	54 trees	81 trees	54 trees	81 trees	54 trees	81 trees	54 trees
o o	o o o	o o	o o o	o o	o o o	o o	o o o	o o
o o	o o o	o						
o o	No. 1		No. 2		No. 3.		No. 4	

Plot No. 1 was sprayed with *dilute Bordeaux (4-4-100)* and ½ lb. Green Arsenoid. Plot No. 2, dilute Bordeaux and ½ lb. Insect Green. Plot No. 3, dilute Bordeaux and ½ lb. Arsenic Lime. Plot No. 4, dilute Bordeaux and 1 lb. arsenate of lead. Applications were made May 21st and 30th with the combined insecticide and fungicide, and July 9th with the dilute Bordeaux alone. The results of this test were that the foliage of the peach, cherry and Japanese plums was slightly injured by the Green Arsenoid and Insect Green, but no injury could be discovered where the Arsenic Lime or arsenate of lead were used.

Numerous prepared insecticides and fungicides have been put on the market the past year, trials of many of which were made in the station orchards and vineyards, but with no results that warrant publication further than to say that good results were obtained with many of them, but their value as compared with the standard preparations cannot be determined without further trial. It would be a great advantage to the farmer and horticulturist if they could purchase ready for use reliable combined insecticides and fungicides at reasonable prices that would be as effective as the fresh home mixed product.

PUMPS AND NOZZLES.

During the past year many new pumps have been put on the market, some of which are improvements upon those formerly in use, but with little or no reduction in price.

The Vermorel nozzle of many forms, the Cyclone, the Bordeaux and other nozzles are now arranged in clusters of from two to five so that a large amount of liquid can be distributed in a short time, thus greatly reducing the cost of spraying large trees.

Hose. After a trial of many kinds of hose, it has been found that, for ordinary spraying, the half-inch hose is the most satisfactory, being less liable to crack from kinking or knotting up, lasting longer and costing less than the three-fourths inch or inch hose.

Pumps, nozzles and hose should be cleaned by running clear water through them after using, and all tubs or barrels used in mixing should have water in them to prevent becoming leaky if left standing in a dry place.

SPRAYING CALENDAR.

PLANT.	FIRST APPLICATION.	SECOND APPLICATION.
APPLE . . . . . (*Scab, codling moth, bud moth, tent caterpillar, canker worm, ptum curculio.*)	When buds are swelling, Bordeaux.	If canker worm and plum curculio are abundant just before blossoms open, Bordeaux and Paris green.
BEAN . . . . . (*Anthracnose, leaf blight.*)	When third leaf expands, Bordeaux.	10 days later, Bordeaux.
CABBAGE . . . . . (*Worms.*)	Inseet powder 1 lb. to 25 lbs. of plaster or cheap flour dusted into the head.	7-10 days later, repeat.
CELERY . . . . . (*Rust and blight.*)	Spray in seed bed with Bordeaux every two weeks.	Dip plants in Bordeaux before planting.
CHERRY* . . . . . (*Rot, aphis, slug, plum curculio, black knot.*)	As buds are breaking, Bordeaux; when aphis appear, kerosene and water.	When fruit has set, Bordeaux and arsenate of lead. If slugs appear, dust leaves with air slacked lime or hellebore.
CURRANT } GOOSEBERRY } . . . . . (*Worms, leaf blight.*)	Spray bushes with Bordeaux before leaves start. At first appearance of worms, hellebore. Thorough application in water.	10 days later, hellebore. Bordeaux.
GRAPE . . . . . (*Fungous diseases, rose bug, etc.*)	In spring when buds swell, Bordeaux.	Just before flowers unfold, Bordeaux and Paris green.
NURSERY STOCK . . . . . (*Fungous diseases.*)	When first leaves appear, Bordeaux and Paris green* or arsenate of lead.	10-14 days, repeat first.
PEACH, NECTARINE* . (*Rot, mildew, scab.*)	As the buds swell, Bordeaux and arsenate of lead for plum curculio.	When fruit has set, Bordeaux and arsenate of lead for curculio.
PEAR . . . . . (*Leaf blight, scab, psylla, codling moth, blister mite.*)	As buds are swelling, Bordeaux.	Just before blossoms open, Bordeaux and Paris green. Kerosene and water when leaves open for psylla.
PLUM*† . . . . . (*Curculio, black knot, leaf blight, brown rot.*)	When buds are swelling, Bordeaux,	When blossoms have fallen, Bordeaux and Paris green. Arsenate of lead in place of Paris green for Japanese plum.
QUINCE. . . . . (*Leaf and fruit spot.*)	When blossom buds appear, Bordeaux and Paris green.	When fruit has set, Bordeaux and Paris green.
RASPBERRY } BLACKBERRY } . . . . . DEWBERRY } (*Rust, anthracnose, leaf blight*)	Before buds break, Bordeaux.	Bordeaux and Paris green just before the blossoms open.
STRAWBERRY . . . . . (*Rust, black Paria, etc.*)	As soon as growth begins, with Bordeaux and Paris green. Dip plants in Bordeaux before setting.	When first blossoms open spray both young and old plantation. Bordeaux and Paris green.
TOMATO . . . . . (*Rot, blight, flea beetle.*)	Soon after planting use Bordeaux.	Repeat as soon as fruit is formed. Fruit can be wiped if disfigured by Bordeaux.
POTATO . . . . . (*Flea beetle, Colorado beetle, blight and rot.*)	Spray with Paris green and Bordeaux when about one-half grown.	Repeat before insects beeome too numerous.

*Paris green cannot be used on foliage of cherry, peach, Japanese plum, apricot and nectarine without injury.

†Black knots on plums or cherries should be cut and burned as soon as discovered

THIRD APPLICATION.	FOURTH APPLICATION.	FIFTH APPLICATION.
When blossoms have fallen, Bordeaux and Paris green.	8-12 days later, Bordeaux and Paris green.	10-14 days later, Bordeaux. Use dilute copper sulfate solution in Sept. for scab if season is wet.
14 days later, Bordeaux.	14 days later, Bordeaux.	Spraying with Bordeaux after the pods are one-half grown will injure them for market.
7-10 days later, repeat.	Repeat in 10-14 days if necessary	
Use Bordeaux until banking begins.	Freedom from disease depends largely upon good cultivation and an abundance of plant food in the soil.	
10-14 days if rot appears, Bordeaux. Arsenate of lead for plum curculio.	10-14 days later, weak solution of copper sulfate, 3 oz. to 50 gallons water.	Repeat after every rain when fruit begins to color.
If worms persist, hellebore.	2 to 4 weeks later, if any disease appears, weak solution of copper sulfate.†	After fruit is gathered, Bordeaux.
When fruit has set, Bordeaux and Paris green.	2 to 4 weeks later, Bordeaux.	Weak solution of copper sulfate.
10-14 days, repeat first.	10-14 days repeat first.	5-7 days later, repeat.
When fruit is one-half grown, Bordeaux.	†5-7 days later, weak solution of copper sulfate.	10-14 days later, weak solution of copper sulfate.
After blossoms have fallen, Bordeaux and Paris green. If necessary, kerosene and water.	8-12 days later, repeat third.	10 20 days later, weak solution of copper sulfate.
10-14 days later, Bordeaux and Paris green.	10-20 days later, Bordeaux.	10-20 days later, copper sulfate solution as fruit is ripening.
10-20 days later Bordeaux.	10-20 days later, Bordeaux.	
(Orange or red rust is treated best by destroying the plants attacked in its early stages.)	Spray after fruit is gathered with Bordeaux.	10-20 days later, repeat.
Spray new plantation Bordeaux.	Repeat third if weather is moist.	
Repeat first when necessary.	†Try weak solution of copper sulfate as fruit begins to ripen.	
Repeat for blight, rot and insects as potatoes approach maturity.		

*For aphides or plant lice, kerosene and water applied in fine mist only in bright drying weather.

†If a pailful of lime wash, well strained, be added to each barrel full of copper solution—4 ounces to 50 gallons—delicate foliage like that of the peach, etc., will not be injured.

HATCH EXPERIMENT STATION

—OF THE—

MASSACHUSETTS

AGRICULTURAL COLLEGE.

BULLETIN NO. 74.

I. ANALYSES OF MANURIAL SUBSTANCES SENT ON FOR EXAMINATION.

II. ANALYSES OF PARIS GREEN AND OTHER INSECTICIDES.

III. INSTRUCTIONS REGARDING THE SAMPLING OF MATERIALS TO BE FORWARDED FOR INVESTIGATION.

IV. DISCUSSION OF TRADE VALUES OF FERTILIZING INGREDIENTS.

V. LAWS FOR THE REGULATION OF THE TRADE IN COMMERCIAL FERTILIZERS IN MASSACHUSETTS.

VI. INSTRUCTIONS TO MANUFACTURERS, IMPORTERS, AGENTS, AND SELLERS OF COMMERCIAL FERTILIZERS.

MARCH, 1901.

AMHERST, MASS.:
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HATCH EXPERIMENT STATION

OF THE

Massachusetts Agricultural College,

AMHERST, MASS.

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The co-operation and assistance of farmers, fruit-growers, horticulturists, and all interested, directly or indirectly, in agriculture, are earnestly requested. The Bulletins will be sent free to all newspapers in the State and to such individuals interested in farming as may request the same. General bulletins, fertilizer analyses, analyses of feed-stuffs, and annual reports are published. Kindly indicate in application which of these are desired. Communications may be addressed to the

HATCH EXPERIMENT STATION, Amherst, Mass.

DIVISION OF CHEMISTRY.

C. A. Goessmann.

I.

ANALYSES OF COMMERCIAL FERTILIZERS AND MANURIAL SUBSTANCES SENT ON FOR EXAMINATION.

WOOD ASHES.

829-833. I. Received from Boston, Mass.
II. Received from Medway, Mass.
III. Received from Gleasondale, Mass.
IV. Received from No. Hatfield, Mass.
V. Received from Lakeville, Mass.

	Per cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	12.67	15.72	1.76	2.15	4.61
Potassium oxide,	3.95	5.69	6.03	3.94	6.30
Phosphoric acid,	1.66	1.48	1.84	1.36	1.22
Calcium oxide,	29.61	32.15	35.95	44.82	34.68
Insoluble matter,	17.57	11.23	18.50	9.93	16.15

834-838. I. Received from Sunderland, Mass.
II. Received from Lakeville, Mass.
III. Received from Haverhill, Mass.
IV. Received from Lakeville, Mass.
V. Received from Chicopee, Mass.

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	17.32	3.37	6.31	14.62	1.57
Potassium oxide,	5.28	5.62	5.85	3.72	6.24
Phosphoric acid,	1.40	1.50	1.87	1.54	2.10
Calcium oxide,	31.06	38.76	35.30	33.20	40.45
Insoluble matter,	12.17	15.33	13.42	13.16	4.33

839-843. I. and II. Received from Chicopee, Mass.
III. Received from Lexington, Mass.
IV. and V. Received from No. Hadley, Mass.

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	1.33	1.35	10.86	3.35	15.60
Potassium oxide,	7.22	6.66	4.82	5.92	5.92
Phosphoric acid,	2.17	2.02	1.22	1.20	1.38
Calcium oxide,	42.00	41.69	36.72	38.52	30.48
Insoluble matter,	3.67	3.72	9.55	10.00	10.94

844-848. I. and II. Received from Sunderland, Mass.
III. Received from No. Amherst, Mass.
IV. and V. Received from Sunderland, Mass.

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	9.70	12.03	14.88	13.68	13.01
Potassium oxide,	7.24	7.62	5.43	6.21	6.55
Phosphoric acid,	1.46	1.50	1.27	1.02	1.65
Calcium oxide,	31.56	33.04	28.13	32.53	30.97
Insoluble matter,	13.99	9.26	19.18	13.59	15.16

COTTON SEED MEAL.

849-853. I. and II. Received from No. Hadley, Mass.
III., IV., and V. Received from No. Hatfield, Mass.

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	5.25	5.57	5.72	7.45	6.92
Nitrogen,	7.20	7.48	7.41	6.66	7.10

854-859. I. and II. Received from No. Hatfield, Mass.
III. Received from Springfield, Mass.
IV. and V. Received from Hatfield, Mass.
VI. Received from Sunderland, Mass.

	Per Cent.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	5.88	5.16	6.92	7.55	7.74	7.04
Nitrogen,	7.10	7.10	7.93	6.97	7.73	6.59
Potassium oxide,	*	*	1.92	*	*	*
Phosphoric acid,	*	*	3.30	*	*	*
Insoluble matter,	*	*	.12	*	*	*

MANURES.

860-862.
I. and II. Hen manure: Received from Amherst, Mass.
III. Sheep manure: Received from Worcester, Mass.

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	41.58	9.66	9.76
Phosphoric acid,	1.21	3.93	1.69
Potassium oxide,	2.96	1.48	2.14
Nitrogen,	1.30	1.83	2.97
Insoluble matter,	*	*	4.11

COMPLETE FERTILIZERS.

863-866. I. Received from Hatfield, Mass.
II. Received from So. Hadley Falls, Mass.
III. and IV. Received from Sunderland, Mass.

*Not determined.

	Per Cent. I.	II.	III.	IV.
Moisture at 100° C.,	7.46	11.10	13.86	11 22
Total phosphoric acid,	10.75	14.10	10.88	9.32
Soluble phosphoric acid,	1.06	.68	4.17	3.42
Reverted phosphoric acid,	6.24	6.28	4.53	4.24
Insoluble phosphoric acid,	3.45	7.14	2.18	1.66
Potassium oxide,	12.34	2.11	5.96	9.46
Nitrogen,	4.00	2.75	2.93	3.50

867-869. I. and II. Received from Natick, Mass.
III. Received from Hatfield, Mass.

	Per Cent. I.	II.	III.
Moisture at 100° C.,	7.77	4.77	6.70
Total phosphoric acid,	45.42	50.14	12.15
Soluble phosphoric acid,	36.46	.26	.74
Reverted phosphoric acid,	7.80	34.14	8.13
Insoluble phosphoric acid,	1.16	15.74	3.28
Potassium oxide,	*	*	11.97
Nitrogen,	*	*	4.63

ANALYSES OF MISCELLANEOUS MATERIAL.

870-874.

I. Vegetable matter, received from Florence, Mass.
II. Sizing paste, received from Sunderland, Mass.
III. Cotton waste, received from Springfield, Mass.
IV. Ashes from hay and straw, received from Hyde Park, Mass.
V. Ashes, "jute waste," received from Ludlow, Mass.

	Per Cent. I.	II.	III.	IV.	V.
Moisture at 100° C.,	69.96	61.45	7.51	.40	.19
Organic and volatile matter,	70.80	94.42	*	*	*
Ash,	29.20	5.58	*	*	*
Total phosphoric acid,	.06	.02	.45	1.02	.54
Potassium oxide,	*	*	1.31	1.55	.51
Nitrogen,	.44	1.13	1.47	*	*
Calcium oxide,	.54	*	2.03	5.22	6.04
Magnesium oxide,	*	*	*	*	.39
Ferric and aluminum oxides,	*	*	*	*	7.60
Sodium oxide,	*	*	*	*	3.84
Sulphuric acid,	*	*	*	*	Trace.
Chlorine,	*	*	*	*	.57
Insoluble matter,	*	*	*	66.35	81.02

875-879. I. Hair waste, received from Saugus, Mass.
II. Fresh cut bone, received from Boston, Mass.
III. Fleshings, received from East Weymouth, Mass.

*Not determined.

IV. Wool Waste, received from Natick, Mass.
V. Sewage, received from Boston, Mass.

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	6.52	24.98	6.96	3.17	56.44
Ash,	22.77	*	43.14	*	*
Total phosphoric acid,	.51	16.85	.31	1.02	.85
Reverted phosphoric acid,	*	5.26	*	*	*
Insoluble phosphoric acid,	*	11.59	*	*	*
Potassium oxide,	.14	*	*	3.74	.27
Nitrogen,	2.22	3.00	7.55	1.61	.77
Sodium oxide,	4.10	*	*	*	*
Insoluble matter,	*	*	*	48.35	20.06

880-884.

I. Bone, received from Worcester, Mass.
II. Tobacco dust, received from Worcester, Mass.
III. Linseed meal, received from Hatfield, Mass.
IV. Havana tobacco grower, received from Sunderland, Mass.
V. Wool waste, received from So. Berlin, Mass.

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	6.28	5.45	7.06	*	7.95
Organic and volatile matter,	33.86	*	*	*	*
Ash,	66.14	*	*	*	*
Total phosphoric acid,	26.78	1.28	1.59	*	.27
Reverted phosphoric acid,	10.05	*	*	*	*
Insoluble phosphoric acid,	16.73	*	*	*	*
Potassium oxide,	*	6.81	1.58	*	1.07
Nitrogen,	3.90	2.16	5.26	*	.39
Chlorine,	*	*	*	10.05	*
Calcium oxide,	*	*	*	*	2.03
Insoluble matter,	*	6.46	.58	*	*

SOILS.

885-889. I., II., III., and IV. Received from Florence, Mass.
V. Received from Amherst, Mass.

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	32.16	55.15	43.87	40.08	8.78
Organic and volatile matter,	47.38	52.39	56.97	46.74	*
Ash,	52.62	47.61	43.03	53 26	*
Potassium oxide,	*	*	*	*	.33
Phosphoric acid,	.67	.20	.21	.09	.10
Nitrogen,	.55	.27	.54	.34	.44
Calcium oxide,	1.22	.12	.63	.75	.49

*Not determined.

890-892. I. Received from Grafton, Mass.
II. and III. Received from Amesbury, Mass.

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.	87.73	58.23	66.60
Organic and volatile matter,	98.67	84.17	86.43
Ash,	1.33	15.83	13.57
Potassium oxide,	*	.15	.12
Phosphoric acid,	.03	.10	.08
Nitrogen,	.38	.59	.46
Calcium oxide,	none	none	none
Ferric and aluminum oxide,	*	1.37	1.03
Chlorine,	*	.01	.02
Acidity,	*	.016	.002

*Not determined.

II.

ANALYSES OF PARIS GREEN AND OTHER INSECTICIDES.

The material, which served for our investigations was collected during the month of December, 1900 and of January, 1901 of dealers in our State.

893-897. I. Paris green manufactured by I. Pfeiffer, New York City. Bought in Springfield, Mass., Dec. 15, 1900.

II. Paris green manufactured by A. B. Ansbacher & Co., New York City. Bought in Springfield, Mass., Dec. 15, 1900.

III. Paris green manufactured by Alsberg & Pfeiffer, New York City. Bought in Springfield, Mass., Dec. 15, 1900.

IV. Paris green manufactured by Hampden Paint & Chemical Co., Springfield, Mass. Bought in Springfield, Mass., Dec. 15, 1900.

V. Paris green manufactured by Cawley, Clark & Co., Newark, N. J. Bought in Springfield, Mass., Dec. 15, 1900.

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	.71	.75	.53	.55	.56
Copper oxide,	30.59	30.14	30.35	30.62	30.61
Arsenious oxide,	57.44	56.40	58.57	56.73	59.72

898-902. I. Paris green "Lion brand," manufactured by Jas. A. Blanchard, New York City. Bought in Boston, Mass., Jan. 15, 1901.

II. Paris green "Lion brand" manufactured by Jas. A. Blanchard, New York City. Bought in Boston, Jan. 15, 1901.

III. Paris green manufactured by A. B. Ansbacher, New York City. Bought in Boston, Mass., Jan. 15, 1901.

IV. Paris green manufactured by Leggett & Bro., New York City. Bought in Worcester, Mass., Jan. 16, 1901.

V. Paris green manufactured by E. & F. King Co., Boston, Mass. Bought in Boston, Mass., Jan. 15, 1901.

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	.60	.34	.60	.56	.52
Copper oxide,	29.85	29.26	30.15	29.73	29.49
Arsenious oxide,	59.38	58.45	57.67	58.08	57.89

903-906. I. Paris green manufactured by C. T. Raynolds & Co., New York City. Bought in Boston, Mass., Jan. 15, 1901.

II. Paris green, "Lion brand, new process," manufactured by Jas. A. Blanchard, New York City. Bought in Boston, Mass., Jan. 15, 1901.

III. Paris green sent in from Amherst, Mass.

IV. Paris green sent in from Amherst, Mass.

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	.55	3.72	.96	.45
Copper oxide,	30.72	21.65	30.65	28.44
Arsenious oxide,	58.03	52.78	58.06	58.99

907-911. I. Pink arsenoid, or lead arsenite, manufactured by Adler Color & Chemical Works, New York City. Sent on by company.

II. Green arsenoid, or copper arsenite, manufactured by Adler Color & Chemical Works, New York City. Sent on by company.

III. White arsenoid, or barium arsenite, manufactured by Adler Color & Chemical Co., New York City. Sent on by company.

IV. Laurel green, manufactured by Nichols Chemical Co., Syracuse, N. Y. Sent in from Amherst, Mass.

V. Bug death, manufactured by Danforth Chemical Co., Leominster, Mass. Sent in from Amherst, Mass.

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	.35	1.44	2.35	7.64	.03
Lead oxide,	53.83	*	.96	*	1.58
Arsenious oxide,	40.16	50.77	31.90	7.34	*
Copper oxide,	*	31.90	*	13.50	*
Barium oxide,	*	*	48.31	*	*
Zinc oxide,	*	*	*	*	78.86
Calcium oxide,	*	*	*	26.31	*
Ferric and Aluminum oxides,	*	*	*	*	3.80
Chlorine,	*	*	3.19	*	*
Carbonic acid,	*	*	8.92	*	*

III.

INSTRUCTIONS REGARDING THE SAMPLING OF MATERIALS TO BE SENT ON FOR EXAMINATION WITH STATEMENTS OF CONDITIONS TO SECURE ANALYSES FREE OF CHARGE.

It is of the utmost importance that parties forwarding fertilizing substances for examination should take particular pains in sampling, packing and forwarding such materials in order that the analyses obtained may represent the average composition of the goods sampled, that no addition or loss of moisture in transportation may be effected and that the package be addressed to the proper department.

All samples are received and entered in the order of their arrival at this office. Each sample is assigned a number and is taken up for investigation in the order in which it has been received.

All samples should be addressed to Dr. C. A. Goessmann, Chemical Department of the Hatch Experiment Station, Amherst, Mass., to prevent confusion and possible delay. Express charges must always be prepaid. **The name of the sender should be enclosed in an envelope and placed inside the receptacle** together with a statement of the nature of the material forwarded for analysis; whether it is an agricultural chemical, mixed fertilizer, a wood ash or the by-product of some manufacturing industry.

The receipt of all samples will be acknowledged by return mail and the results of analysis will be forwarded free of charge to all farmers as soon as completed.

The results of all analyses of samples made at the Station, free of charge, are considered at the disposal of the managers for publication if deemed advisable.

SAMPLING OF MATERIAL IN BULK.

In sampling such materials as wood ashes, cotton hull ashes and in fact any material in bulk, portions should be taken from various parts of the heap and placed on a thick, smooth piece of paper and thoroughly mixed; from this mixture should be drawn a sample of about one pound which should be placed in a clean bottle, jar or tin can tightly stoppered and sealed in order to retain the moisture conditions of the original material.

SAMPLING OF MATERIAL IN BAGS.

In sampling material which is shipped in bags, portions should be drawn from at least ten per cent of the number of bags present. A fair sample may be obtained by emptying about ten per cent of the bags present on a clean floor or other smooth surface and thoroughly mixing; small amounts are then taken from different parts of the heap and an average sample drawn as has been previously described.

SAMPLING OF SOILS.

The correct taking of representative soil samples, when such are desired for chemical investigation, is of the first importance, as without a properly taken sample, the results which a careful chemical analysis will show become of little value. The sample should be taken from different portions of the field and to a depth not exceeding the downward limit of the surface soil. After selecting a place where a sample is to be taken, pull up all growing vegetation and remove all surface matter which is not a part of the soil. Dig a hole in the soil about two feet square, making the sides smooth and clean by means of a sharp pointed shovel or other instrument; now place a sharp bladed shovel at the point of separation of the surface soil from the subsoil and by means of another flat bladed instrument shave off a portion (about two inches) from all four sides of the aperture letting the soil fall into a shovel which is held in a proper position to receive the same. Place the soil in a suitable receptacle and proceed to take other samples in a like manner from several different parts of the field. The large bulk of soil which has thus

been taken is now placed on a clean floor or on a large piece of thick paper and thoroughly broken up and mixed, after which an average sample is drawn and placed in a glass jar or bottle. The bottle is then securely stoppered and sealed, properly labelled and forwarded for the subsequent chemical examination.

A description of the soil should accompany the sample or be sent in a sealed letter, setting forth the locality, depth at which the sample was taken, nature of subsoil and depth, the method of fertilization and crop rotation which has been in practice, general fitness of land for cultivation and all other information that would be of interest or assistance to the chemist in formulating his report.

Care should be exercised in sampling when the weather conditions are normal and no time should be lost between the drawing of the sample and the forwarding of same to the laboratory. This point applies with equal force to all materials forwarded for investigation.

STATEMENT OF CONDITIONS TO SECURE ANALYSES FREE OF CHARGE.

APPLICATION FOR FREE ANALYSIS OF FERTILIZERS AND FERTILIZING MATERIAL.

Name of Material, _____

Name of manufacturer or dealer, _____

Address of manufacturer or dealer, _____

Date of purchase, _____

Price paid per ton, _____

Whether bought for own use or for sale, _____

Signature of Applicant, _____

Post Office Address, _____

A printed copy of the above stated questions will be sent hereafter from this office *to every applicant for an analysis free of charge*, to be answered by him according to his best information, before his request can be considered.

The object of this course is to impart a more general interest in the results of this work of the Station and to assist in an efficient management of the official inspection of commercial fertilizers and fertilizing materials by making known the names of licensed as well as unlicensed dealers in our State.

The call for free analysis has gradually reached such proportions that the expenses necessarily incurred in the work have become a serious feature in the management of the financial resources at our disposal.

It is to be hoped that all parties interested in this important work of the Station will aid us by complying with our request.

IV.

DISCUSSION OF TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	1901.	1900.
	Cents per pound.	
Nitrogen in ammonia salts,	16.5	17.0
" nitrates,	14.0	13.5
Organic nitrogen in dry and fine ground fish, meat, blood, and in high-grade mixed fertilizers,	16.0	15.5
" " " fine bone and tankage,	16.0	15.5
" " " medium bone and tankage,	12.0	11.0
Phosphoric acid soluble in water,	5.0	4.5
" " soluble in ammonium citrate,	4.5	4.5
" " in fine ground fish, bone and tankage,	4.0	4.5
" " in cottonseed meal, castor pomace and wood ashes,	4.0	4.0
" " in coarse fish, bone and tankage,	3.0	3.0
" " insoluble (in water and in am. cit.) in mixed fertilizers,	2.0	2.0
Potash as Sulphate, free from Chlorides,	5.0	5.0
" " Muriate,	4.25	4.25

The market value of low priced materials used for manurial purposes, as salt, wood ashes, various kinds of lime, barnyard manure, factory refuse and waste materials of different description, quite frequently does not stand in close relation to the current market value of the amount of essential articles of plant food they contain. Their cost varies in different localities. Local facilities for cheap transportation and more or less advantageous mechanical conditions for a speedy action, exert as a rule, a decided influence on their selling price.

The market cost of the different essential elements of plant food, with the exception of the nitrogen compounds and available phosphoric acid compares favorably with the prices of the same ingredients for the year 1900. Nitrogen compounds with the exception of the

ammonia salts show a material increase in cost as compared with the previous year.

The above schedule of trade values is based upon the condition of the fertilizer market in centres of distribution in New England during the six months preceding March 1900 and refers to the current market prices of the leading standard raw materials which enter largely into the manufacture of our commercial fertilizers.

The following is a list of such materials :

Sulphate of Ammonia,	Dissolved bone,
Nitrate of Soda,	Ground phosphate rock,
Azotine,	Acid phosphate,
Dried blood,	Refuse bone black,
Cotton seed meal,	High grade sulphate of potash,
Castor pomace,	Muriate of potash,
Linseed meal,	Sulphate of potash-magnesia,
Dry ground fish,	Kainit,
Bone and tankage,	Sylvinite,
Dry ground meat,	Crude saltpetre.

Valuation. The approximate value of a compound fertilizer or any material used for fertilizing purposes is obtained by calculating the value of each of the three essential elements of plant food (nitrogen, phosphoric acid and potassium oxide, including the different forms of each wherever different forms are recognized in the table), in one hundred pounds of the fertilizer and multiply each product by twenty to change it to a ton basis. The sum of these values will give the total approximate value of the fertilizer per ton at the principal places of distribution.

V.

LAWS FOR THE REGULATION OF THE TRADE IN COMMERCIAL FERTILIZERS IN MASSACHUSETTS.

AN ACT TO REGULATE THE SALE OF COMMERCIAL FERTILIZERS.

Acts for 1896, Chapter 297.

Be it enacted, etc., as follows:

SECTION 1. Every lot or parcel of commercial fertilizer or fertilizer material sold or offered or exposed for sale within this Commonwealth shall be accompanied by a plainly printed statement, clearly and truly certifying the number of net pounds of fertilizer in

the package, the name, brand or trade-mark under which the fertilizer is sold, the name and address of the manufacturer or importer, the location of the factory, and a chemical analysis stating the percentage of nitrogen, of potash soluble in distilled water, and of phosphoric acid in available form soluble in distilled water and reverted, as well as the total phosphoric acid. In the case of those fertilizers which consist of other and cheaper materials said label shall give a correct general statement of the composition and ingredients of the fertilizer it accompanies.

Section 2. Before any commercial fertilizer is sold or offered or exposed for sale the importer, manufacturer or party who causes it to be sold or offered for sale within this Commonwealth shall file with the director of the Hatch experiment station of the Massachusetts Agricultural College a certified copy of the statement named in section one of this act, and shall also deposit with said director at his request, a sealed glass jar or bottle containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.

Section 3. The manufacturer, importer, agent or seller of any brand of commercial fertilizer or fertilizer material shall pay for each brand, on or before the first day of May annually, to the director of the experiment station, an analysis fee of five dollars for each of the three following fertilizing ingredients: namely, nitrogen, phosphorus and potassium, contained or claimed to exist in said brand of fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any person acting as agent or seller for such manufacturer or importer, such agent or seller shall not be required to pay the fee named in this section; and on receipt of said analysis fees and statement specified in section two the director of said station shall issue certificates of compliance with this act.

Section 4. No person shall sell or offer or expose for sale in this Commonwealth any pulverized leather, hair or wool waste, raw, steamed, roasted or in any form as a fertilizer, or as an ingredient of any fertilizer or manure, without an explicit printed certificate of the fact, said certificate to be conspicuously affixed to every package of such fertilizer or manure, and to accompany or go with every parcel or lot of the same.

Section 5. Any person selling or offering or exposing for sale any commercial fertilizer without the statement required by the first

section of this act, or with a label stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, or respecting the sale of which all the provisions of the foregoing section have not been fully complied with, shall forfeit fifty dollars for the first offence and one hundred dollars for each subsequent offence.

Section 6. This act shall not affect parties manufacturing, importing or purchasing fertilizers for their own use and not to sell in this Commonwealth.

Section 7. The director of the experiment station shall pay the analysis fees, as soon as received by him, into the treasury of the station, and shall cause one analysis or more of each fertilizer or fertilizer material to be made annually, and shall publish the results from time to time, with such additional information as the circumstances render advisable, provided such information relates only to the composition of the fertilizer or fertilizer material inspected. Said director is hereby authorized in person or by deputy to take a sample, not exceeding two pounds in weight, for analysis, from any lot or package of fertilizer or fertilizer material which may be in the possession of any manufacturer, importer, agent or dealer; but said sample shall be drawn in the presence of said party or parties in interest, or their representative, and taken from a parcel or a number of packages which shall be not less than ten per cent of the whole lot inspected, and shall be thoroughly mixed and then divided into two equal samples and placed in glass vessels, and carefully sealed and a label placed on each, stating the name or brand of the fertilizer or material sampled, the name of the party from whose stock the sample was drawn, and the time and place of drawing; and said label shall also be signed by the director or his deputy and by the party or parties in interest, or their representatives present at the drawing and sealing of said sample; one of said duplicate samples shall be retained by the director and the other by the party whose stock was sampled. All parties violating this act shall be prosecuted by the director of said station.

Section 8. Chapter two hundred and ninety-six of the acts of the year eighteen hundred and eighty-eight is hereby repealed.

Section 9. This act shall take effect on the first day of November in the year eighteen hundred and ninety-six.

[*Approved April 17, 1896.*

VI.

INSTRUCTIONS TO MANUFACTURERS, IMPORTERS, AGENTS AND SELLERS OF COMMERCIAL FERTILIZERS AND MATERIALS USED FOR MANURIAL PURPOSES IN MASSACHUSETTS.

1. An application for a certificate of compliance with the regulations of the trade in commercial fertilizers and materials used for manurial purposes in this state must be accompanied:

First, with a distinct statement of the name of each brand offered for sale, the name of the manufacturer and place of factory.

Second, with a statement of the amount of phosphoric acid, of nitrogen and of potassium oxide guaranteed in each distinct brand.

Third, with the fee charged by the State for a certificate, which is five dollars for each of the following articles: nitrogen, phosphoric acid and potassium oxide guaranteed in any distinct brand.

2. The obligation to secure a certificate applies not only to compound fertilizers but to all substances, single or compound, used for manurial purposes offered for sale in this State.

3. The certificate of compliance with our State laws must be secured annually before the first of May.

4. Manufacturers, importers and dealers in commercial fertilizers can appoint in this State as many agents as they desire after having secured at this office the certificate of compliance with our laws.

5. Agents of manufacturers, importers and dealers in commercial fertilizers are held personally responsible for their transactions until they can prove that the articles they offer for sale are duly recorded in this office.

6. Manufacturers and importers are requested to furnish a list of their agents.

All inquiries regarding the sales of commercial fertilizers, etc., may be addressed to C. A. Goessmann, Amherst, Mass., Chemist in charge of the official inspection of these articles.

HATCH EXPERIMENT STATION

—OF THE—

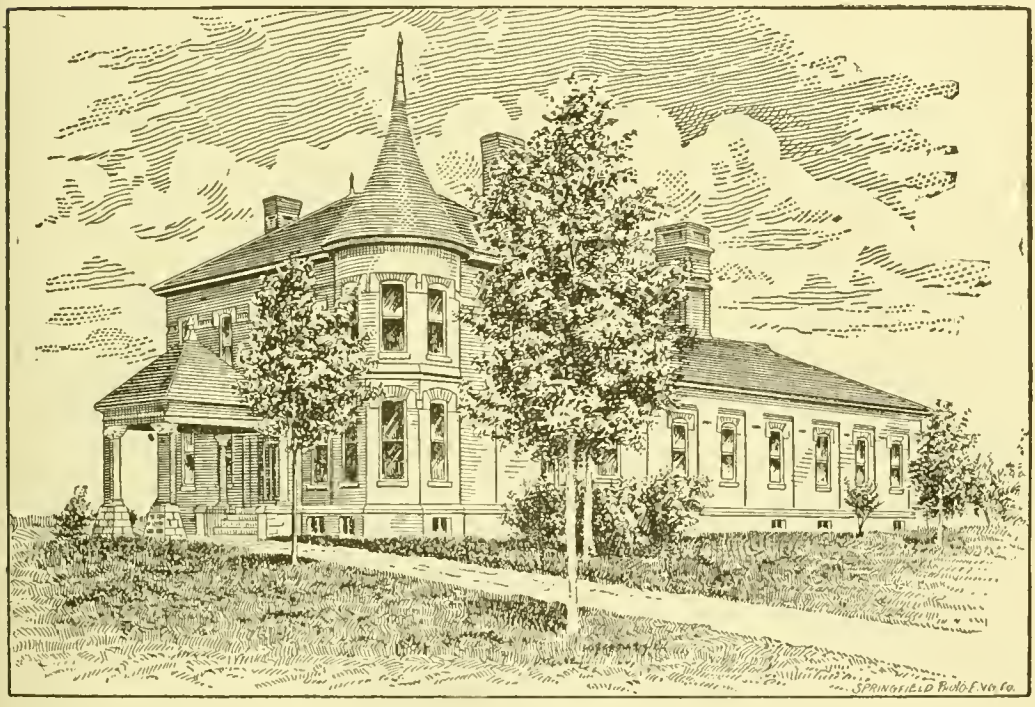
MASSACHUSETTS

AGRICULTURAL COLLEGE.

BULLETIN NO. 75.

I. ANALYSES OF MANURIAL SUBSTANCES SENT ON FOR EXAMINATION.

II. ANALYSES OF LICENSED FERTILIZERS COLLECTED BY THE AGENT OF THE STATION DURING 1901.



CHEMICAL LABORATORY.

JULY, 1901.

The Bulletins of this Station will be sent free to all newspapers in the State and to such individuals interested in farming as may request the same.

AMHERST, MASS.:
PRESS OF CARPENTER & MOREHOUSE,
1901.

HATCH EXPERIMENT STATION

OF THE

Massachusetts Agricultural College,

AMHERST, MASS.

STATION STAFF:

HENRY H. GOODELL, LL. D.,	*Director.*
WILLIAM P. BROOKS, PH. D.,	*Agriculturist.*
GEORGE E. STONE, PH. D.,	*Botanist.*
CHARLES A. GOESSMANN, PH. D., LL. D.,	*Chemist* (Fertilizers).
JOSEPH B. LINDSEY, PH. D.,	*Chemist* (Foods and Feeding).
CHARLES H. FERNALD, PH. D.,	*Entomologist.*
SAMUEL T. MAYNARD, B. SC.,	*Horticulturist.*
J. E. OSTRANDER, C. E.,	*Meteorologist.*
HENRY T. FERNALD, PH. D.,	*Associate Entomologist.*
HENRY M. THOMSON, B. SC.,	*Assistant Agriculturist.*
RALPH E. SMITH, B. SC.,	*Assistant Botanist.*
HENRI D. HASKINS, B. SC.,	*Assistant Chemist* (Fertilizers).
SAMUEL W. WILEY, B. SC.,	*Assistant Chemist* (Fertilizers).
JAMES E. HALLIGAN, B. SC.,	*Assistant Chemist* (Fertilizers).
EDWARD B. HOLLAND, M. SC.,	*First Chemist*(Foods and Feeding).
PHILIP H. SMITH, B. SC.,	*Ass't Chemist*(Foods and Feeding).
JAMES W. KELLOGG, B. SC.,	*Ass't Chemist*(Foods and Feeding).
GEORGE A. DREW, B. SC..	*Assistant Horticulturist.*
RALPH I. SMITH, B. SC.,	*Assistant Horticulturist.*
CHARLES L. RICE,	*Observer.*

The co-operation and assistance of farmers, fruit-growers, horticulturists, and all interested, directly or indirectly, in agriculture, are earnestly requested. The Bulletins will be sent free to all newspapers in the State and to such individuals interested in farming as may request the same. General bulletins, fertilizer analyses, analyses of feed-stuffs, and annual reports are published. Kindly indicate in application which of these are desired. Communications may be addressed to the

HATCH EXPERIMENT STATION, Amherst, Mass.

DIVISION OF CHEMISTRY.

C. A. Goessmann.

I.

ANALYSES OF COMMERCIAL FERTILIZERS AND MANURIAL SUBSTANCES SENT ON FOR EXAMINATION.

WOOD ASHES.

912-916. I. Received from Sunderland, Mass.
II. and III. Received from North Hatfield, Mass.
IV. and V. Received from North Amherst, Mass.

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	13.84	7.48	7.91	10.16	15.70
Potassium oxide,	6.18	5.69	5.05	6.14	6.25
Phosphoric acid,	1.00	1.43	1.82	1.51	1.59
Calcium oxide,	31.95	30.01	35.23	34.59	27.88
Insoluble matter,	13.03	21.73	13.94	16.26	12.03

917-921. I. Received from Boston, Mass.
II. and III. Received from Sunderland, Mass.
IV. Received from North Hadley, Mass.
V. Received from Hawley, Mass.

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	.33	12.50	11.16	3.34	2.13
Potassium oxide,	6.27	6.39	4.31	8.23	4.71
Phosphoric acid,	1.23	1.48	1.23	1.84	1.82
Calcium oxide,	45.26	35.72	38.23	38.23	33.04
Insoluble matter,	3.66	8.19	10.56	15.71	7.33

922-926. I. Received from Worcester, Mass.
II. Received from Hingham, Mass.
III. Received from Newton Centre, Mass.
IV. Received from South Acton, Mass.
V. Received from Boston, Mass.

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	12.32	7.40	9.97	4.08	8.40
Potassium oxide,	5.68	8.36	5.60	8.52	7.48
Phosphoric acid,	1.40	1.66	1.23	1.51	1.56
Calcium oxide,	30.00	30.50	34.22	35.25	37.39
Insoluble matter,	7.36	10.45	12.75	11.33	9.48

927-929. I. Received from Shrewsbury, Mass.
II. Received from Worcester, Mass.
III. Received from Boston, Mass.

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	4.73	11.47	20.12
Potassium oxide,	7.28	5.92	6.56
Phosphoric acid,	1.48	1.54	1.58
Calcium oxide,	34.79	34.62	29.48
Insoluble matter,	13.74	8.56	33.56

LIME KILN ASHES AND COTTON HULL ASHES.

930-931. I. Lime Kiln Ashes, received from No. Hatfield, Mass.
II. Cotton Hull Ashes, received from Springfield, Mass.

	Per Cent.	
	I.	II.
Moisture at 100° C.,	.47	9.87
Potassium oxide,	4.72	27.96
Phosphoric acid,	1.56	8.32
Calcium oxide,	35.10	—
Insoluble matter,	22.30	16.38

POTASH COMPOUNDS.

932-933.

I. and II. Muriate of Potash, received from Hudson, Mass.

	Per Cent.	
	I.	II.
Moisture at 100° C.,	3.86	2.25
Potassium oxide,	47.70	51.72

NITROGEN COMPOUNDS.

934-936. I. Nitrate of Soda, received from Amherst, Mass.
II. Nitrate of Soda, received from Hudson, Mass.
III. Sulphate of Ammonia, collected at Sunderland, Mass.

	Per Cent. I.	II.	III.
Moisture at 100° C.,	1.60	1.82	.45
Nitrogen,	15.88	15.07	21.29

COTTON SEED MEAL.

937-940.

I. Received from Sunderland, Mass.
II. Received from North Hatfield, Mass.
III. Received from North Hadley, Mass.
IV. Received from Westfield, Mass.

	Per Cent. I.	II.	III.	IV.
Moisture at 100° C.,	6.81	6.13	6.68	5.82
Nitrogen,	7.28	7.20	6.94	7.58

TANKAGE AND BONE.

941-944.

I. Tankage, received from Hoosac Tunnel, Mass.
II. Dissolved Bone Meal, received from Amherst, Mass.
III. Steamed Bone Meal, received from Amherst, Mass.
IV. Raw Bone Meal, received from Amherst, Mass.

	Per Cent. I.	II.	III.	IV.
Moisture at 100° C.,	3.17	4.70	2.77	6.65
Total Phosphoric acid,	18.78	22.26	25.20	23.80
Soluble Phosphoric acid,	—	2.90	—	—
Reverted Phosphoric acid,	—	14.62	11.16	11.52
Insoluble Phosphoric acid,	—	4.74	14.04	12.28
Nitrogen,	4.11	1.66	2.65	3.81

945-948.

I. Ground Bone, received from Hudson, Mass.
II. Ground Bone, collected in Sunderland, Mass.
III. Undried Tankage, received from Northboro, Mass.
IV. Condensed Bone Steam, received from Northboro, Mass.

	Per Cent. I.	II.	III.	IV.
Moisture at 100° C.,	3.77	2.38	29.00	81.75
Total Phosphoric acid,	22.80	19.62	3.51	.07
Available Phosphoric acid,	10.37	7.08	2.94	—
Insoluble Phosphoric acid,	12.43	12.54	.57	—
Nitrogen,	2.85	4.53	1.06	1.94

MISCELLANEOUS PHOSPHORIC ACID COMPOUNDS.

949-952.

I. Tennessee Phosphate, received from Amherst, Mass.
II. Acid Phosphate, received from Amherst, Mass.
III. Plain Superphosphate, collected in Sunderland, Mass.
IV. Dissolved Bone Black, received from Amherst, Mass.

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	.37	13.42	10.97	11.25
Total Phosphoric acid,	33.00	16.12	15.74	18.42
Soluble Phosphoric acid,	—	8.70	8.06	11.12
Reverted Phosphoric acid,	—	5.04	6.20	6.14
Insoluble Phosphoric acid,	—	2.38	1.48	1.16

COMPLETE FERTILIZERS.

953-955.

I. Received from Hingham, Mass.
II. Received from Enfield, Mass.
III. Collected in Sunderland, Mass.

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	9.40	4.93	7.25
Total Phosphoric acid,	13.41	3.91	6.78
Soluble Phosphoric acid,	7.29	—	3.84
Reverted Phosphoric acid,	3.48	1.95	1.92
Insoluble Phosphoric acid,	2.64	1.96	1.02
Potassium oxide,	2.33	15.42	10.66
Nitrogen,	2.18	6.34	5.25

BARNYARD MANURES.

956-957.

I. Received from Sunderland, Mass.
II. Received from Amherst, Mass.

	Per Cent.	
	I.	II.
Moisture at 100° C.,	68.67	66 61
Phosphoric acid,	.41	.40
Potassium oxide,	.66	.61
Nitrogen,	.53	.52
Insoluble matter,	6.64	—

MUCK.

958-959. I. and II. Received from Amherst, Mass.

	Per Cent.	
	I.	II.
Moisture at 100° C.,	3.43	2.23
Phosphoric acid,	trace.	.31
Calcium oxide,	.78	.77
Nitrogen,	.43	.32

II. ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1901, IN THE GENERAL MARKETS BY THE AGENT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
248	Blood, Bone and Potash,	Armour Fertilizer Works, Baltimore, Md.,	Harvard.
320	Blood, Bone and Potash,	Armour Fertilizer Works, Baltimore, Md.,	Danvers.
282	High Grade Potato Fertilizer,	Armour Fertilizer Works, Baltimore, Md.,	Danvers.
292	High Grade Potato Fertilizer,	Armour Fertilizer Works, Baltimore, Md.,	Harvard.
442	Armour's Flower Food,	Armour Packing Co., Kansas City, Kansas,	Amherst.
326	Abbott's Tobacco Fertilizer,	W. H. Abbott, Holyoke, Mass.,	Amherst.
367	Abbott's Tobacco Fertilizer,	W. H. Abbott, Holyoke, Mass.,	Whately.
9	Cotton Hull Ashes,	American Cotton Oil Co., New York City,	Sunderland.
110	Farquhar's Lawn and Garden Dressing,	Bartlett & Holmes, Springfield, Mass.,	Boston.
144	Farquhar's Lawn and Garden Dressing,	Bartlett & Holmes, Springfield, Mass.,	Boston.
389	Farquhar's Lawn and Garden Dressing,	Bartlett & Holmes, Springfield, Mass.,	Springfield.
24	A. A. Ammoniated Superphosphate,	American Agric. Chem. Co. (H. J. Baker & Bro., N. Y.)	Springfield.
120	A. A. Ammoniated Superphosphate,	American Agric. Chem. Co. (H. J. Baker & Bro., N. Y.)	Falmouth.
185	A. A. Ammoniated Superphosphate,	American Agric. Chem. Co. (H. J. Baker & Bro., N. Y.)	New Bedford.
413	A. A. Ammoniated Superphosphate,	American Agric. Chem. Co. (H. J. Baker & Bro., N. Y.)	Worcester.
89	Hill and Drill Phosphate.	Bowker Fertilizer Co., Boston, Mass.,	Boston.
111	Hill and Drill Phosphate,	Bowker Fertilizer Co., Boston, Mass.,	Boston.
178	Hill and Drill Phosphate,	Bowker Fertilizer Co., Boston, Mass.,	Boston.
232	Hill and Drill Phosphate,	Bowker Fertilizer Co., Boston, Mass.,	Leominster.
36	Lawn and Garden Dressing,	Bowker Fertilizer Co., Boston, Mass.,	Springfield.
59	Lawn and Garden Dressing,	Bowker Fertilizer Co., Boston, Mass.,	Taunton.
98	Potato and Vegetable Manure,	Bowker Fertilizer Co., Boston, Mass.,	Dighton.
270	Potato and Vegetable Manure,	Bowker Fertilizer Co., Boston, Mass.,	Lowell.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
248-320	Blood, Bone and Potash,	10.11	3.21	4.11-4.94	6.78	3.14	.90	10.82	10-12	9.92	8-10	5.84	7-8*
282-292	High Grade Potato Fertilizer,	7.88	2.13	1.64-2.47	6.63	3.17	1.18	10.98	10-12	9.80	8-10	9.60	10-12
442	Armour's Flower Food,†	3.70	6.79	7-7.41	1.50	12.70	—	14.20	—	14.20	14-15	13.68	12-13
326-367	Abbott's Tobacco Fertilizer,	13.31	4.68	4.5-5.5	1.34	10 07	.90	12.31	12-14	11.41	11-14	10.08	10-11*
9	Cotton Hull Ashes,	2.10	—	—	—	—	—	8.78	8-10	—	—	30.12	20-30
11C-144-389	Farquhar's Lawn and Garden Dressing,	5.41	4.39	3.30-4.12	.49	6.21	6.63	13.33	14-17	6.70	4-5	7.00	7-8
24-120-185-413	A. A. Ammoniated Superphosphate,	14.28	2.35	2.5-3.25	6.95	2.34	3.02	12.31	11-14	9.29	9-11	2.30	2-3
89-111-178-232	Hill and Drill Phosphate,	10.85	2.25	2.25-3.25	5 50	4.64	1.89	12.03	11-13	10.14	9-11	2.44	2-3
36-59	Lawn and Garden Dressing,	8.56	3.30	3-4	1.92	4.53	2.12	8.57	8-10	6.45	6-8	4.64	5-6
98-270	Potato and Vegetable Manure,	14.51	3.18	2.25-3.25	6.50	2.28	1.61	10.39	11-13	8.78	8-10	4.12	4-6

*Sulphate of Potash, the source of Potash.

†Collected during the season of 1900.

II. ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1901, IN THE GENERAL MARKETS BY THE AGENT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
215	High Grade Fertilizer,	Bowker Fertilizer Co., Boston, Mass.,	Leominster.
239	High Grade Fertilizer,	Bowker Fertilizer Co., Boston, Mass.,	Beverly.
296	High Grade Fertilizer,	Bowker Fertilizer Co., Boston, Mass.,	Lowell.
186	Bone and Wood Ash Fertilizer,	Bowker Fertilizer Co., Boston, Mass.,	Boston.
306	Bone and Wood Ash Fertilizer,	Bowker Fertilizer Co., Boston, Mass.,	Lowell.
29	Stockbridge's Potato and Vegetable,	Bowker Fertilizer Co., Boston, Mass.,	Springfield.
46	Stockbridge's Potato and Vegetable,	Bowker Fertilizer Co., Boston, Mass.,	Fall River.
93	Stockbridge's Potato and Vegetable,	Bowker Fertilizer Co., Boston, Mass.,	Dighton.
7	X. L. Superphosphate of Lime,	American Agric. Chem. Co. (Bradley Fertilizer Co.),	Sunderland.
83	X. L. Superphosphate of Lime,	American Agric. Chem. Co. (Bradley Fertilizer Co.),	Whittenton.
79	Bradley's Potato Manure,	American Agric. Chem. Co. (Bradley Fertilizer Co.),	Whittenton.
153	Bradley's Potato Manure,	American Agric. Chem. Co. (Bradley Fertilizer Co.),	Needham.
222	Bradley's Potato Manure,	American Agric. Chem. Co. (Bradley Fertilizer Co.),	Gloucester.
243	Bradley's Potato Fertilizer,	American Agric. Chem. Co. (Bradley Fertilizer Co.),	Marlboro.
321	Bradley's Potato Fertilizer,	American Agric. Chem. Co. (Bradley Fertilizer Co.),	Newburyport.
38	Complete Manure for Potatoes and Vegetables,	American Agric. Chem. Co. (Bradley Fertilizer Co.),	Weir.
106	Complete Manure for Potatoes and Vegetables,	American Agric. Chem. Co. (Bradley Fertilizer Co.),	Bridgewater.
297	Complete Manure for Potatoes and Vegetables,	American Agric. Chem. Co. (Bradley Fertilizer Co.),	Lowell.
221	Bradley's Corn Phosphate,	American Agric. Chem. Co. (Bradley Fertilizer Co.),	Wenham.
277	Bradley's Corn Phosphate,	American Agric. Chem. Co. (Bradley Fertilizer Co.),	Newburyport.
166	Breck's Lawn and Garden Dressing,	American Agric. Chem. Co. (Bradley Fertilizer Co.),	Boston.
214	Bradley's Eclipse Phosphate,	American Agric. Chem. Co. (Bradley Fertilizer Co.),	Ayer Junction.
280	Bradley's Eclipse Phosphate,	American Agric. Chem. Co. (Bradley Fertilizer Co.),	Lowell.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
215-239-296	High Grade Fertilizer,	15.00	2.30	2.25-3.25	6.52	2.23	1.66	10.41	10-13	8.75	7-10	4.28	4-5
186-306	Bone and Wood Ash Fertilizer,	13.53	1.58	1.5-2.5	—	6.65	2.48	9.13	8-10	6.65	6-8	2.52	2-3*
29-46-93	Stockbridge's Potato and Vegetable,	11.95	2.92	3-4	3.62	2.83	1.82	8.27	8-10	6.45	6-8	10.00	10-12
7-83	X. L. Superphosphate of Lime,	13.62	2.50	2.5-3.25	6.87	3.39	2.10	12.36	11-14	10.26	9-11	2.44	2-3
79-153-222	Bradley's Potato Manure,	11.38	2.40	2.5-3.25	3.36	3.02	2.58	8.96	8-11	6.38	6-8	5.42	5-6
243-321	Bradley's Potato Fertilizer,	12.25	1.93	2.06-2.88	6.88	1.97	3.71	12.56	10-13	8.85	8-10	3.52	3-4
38-106-297	Complete Manure for Potatoes and Veg'bles	11.13	3.41	3.30-4.12	5.48	3.50	1.69	10.67	9-13	8.98	8-11	7.18	7-8
221-277	Bradley's Corn Phosphate,	13.54	2.11	2.06-2.88	6.05	2.06	3.76	11.87	10-13	8.11	8-10	1.84	1.5-2.5
166	Breck's Lawn and Garden Dressing,	7.79	4.85	4.10-4.94	2.94	2.13	1.10	6.17	6-8	5.07	5-6	5.88	5-6
214-280	Bradley's Eclipse Phosphate,	14.73	1.35	1.03-2.5	5.25	3.52	2.23	11.00	10-15	8.77	8-11	2.14	2-3

*Sulphate of Potash, the source of Potash.

II. ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1901, IN THE GENERAL MARKETS BY THE AGENT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
172	Breck's Market Garden Manure,	Joseph Breck & Sons, Boston, Mass.,	Boston.
133	Bay State Fertilizer,	American Agric. Chem. Co. (Clark's Cove Fertilizer Co.)	Dighton.
167	Bay State Fertilizer,	American Agric. Chem. Co. (Clark's Cove Fertilizer Co.)	Falmouth.
393	Bay State Fertilizer,	American Agric. Chem. Co. (Clark's Cove Fertilizer Co.)	Monson.
85	Bay State Fertilizer G. G.,	American Agric. Chem. Co. (Clark's Cove Fertilizer Co.)	Hudson.
104	Potato Fertilizer,	American Agric. Chem. Co. (Clark's Cove Fertilizer Co.)	Hudson.
378	Potato Fertilizer,	American Agric. Chem, Co. (Clark's Cove Fertilizer Co.)	Monson.
260	King Philip Alkaline Guano,	American Agric. Chem. Co. (Clark's Cove Fertilizer Co.)	Winchendon.
414	King Philip Alkaline Guano,	American Agric. Chem. Co. (Clark's Cove Fertilizer Co.)	Spencer.
209	High Grade Potato Fertilizer,	E. Frank Coe Co., New York City,	Winchendon.
134	High Grade Ammoniated Bone Superphosphate,	E. Frank Coe Co., New York City,	Dighton.
317	High Grade Ammoniated Bone Superphosphate,	E. Frank Coe Co., New York City,	Winchendon.
344	High Grade Ammoniated Bone Superphosphate,	E. Frank Coe Co., New York City,	Westfield.
383	High Grade Ammoniated Bone Superphosphate,	E. Frank Coe Co., New York City,	Lee.
159	Gold Brand Excelsior Guano,	E. Frank Coe Co., New York City,	Dighton.
152	American Farmers' Corn King,	E. Frank Coe Co., New York City,	Dighton.
48	Fish and Potash,	E. Frank Coe Co., New York City,	Seekonk.
220	Crocker's Potato, Hop and Tobacco Phosphate,	American Agric. Chem. Co. (Crocker Fert. & Chem. Co.)	Haverhill.
319	Crocker's Potato, Hop and Tobacco Phosphate,	American Agric. Chem. Co. (Crocker Fert. & Chem. Co.)	Amesbury.
224	New Rival Ammoniated Superphosphate,	American Agric. Chem. Co. (Crocker Fert. & Chem. Co.)	Haverhill.
301	New Rival Ammoniated Superphosphate,	American Agric. Chem. Co. (Crocker Fert. & Chem. Co.)	Amesbury.
380	Crocker's General Crop Phosphate,	American Agric. Chem. Co. (Crocker Fert. & Chem. Co.)	Lee.
238	Crocker's A. A. Complete Manure,	American Agric. Chem. Co. (Crocker Fert. & Chem. Co.)	Haverhill.
400	Crocker's A. A. Complete Manure,	American Agric. Chem. Co. (Crocker Fert. & Chem. Co.)	Worcester.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
172	Breck's Market Garden Manure,	13.84	2.50	2.5-3.25	8.03	2.10	2.38	12.51	11-14	10.13	9-11	2.38	2-3
133-167-393	Bay State Fertilizer,	13.90	2.54	2.5-3.25	7.80	2.46	2.48	12.74	11-14	10.26	9-11	2.52	2-3
85	Bay State Fertilizer G. G.,	11.40	2.18	2.06-2.50	5.41	3.44	3.51	12.36	10-13	8.85	8-10	1.96	1.5-2.5
104-378	Potato Fertilizer,	12.39	2.06	2.06-2.88	6.24	2.58	3.33	12.15	10 13	8.82	8-10	3.28	3-4
260-414	King Philip Alkaline Guano,	15.17	1.23	1.03-2.50	5.48	3.01	2.38	10.87	10-15	8.49	8-12	2.18	2-3
209	High Grade Potato Fertilizer,	8.77	2.70	2-3	5.95	2.20	2.62	10.77	8.5-9.5	8.15	7.5-9	6.36	6-7*
134 317-344-383	High Grade Ammoniated Bone Superphos.,	10.70	1.85	1.85-2.00	6.75	2.72	2.25	11.72	10.5-11	9.47	9-10	2.5	2.25-3.25*
159	Gold Brand Excelsior Guano,	8.60	2.82	2.4 3	6.63	.92	3.17	10.72	9-10	7.55	7.5-9	6.00	6-7*
152	American Farmers' Corn King,	11.71	2.57	2.4-3	7.16	2.28	1.92	11.36	9.5-10.5	9.44	8-10	3.67	4-5*
48	Fish and Potash,	11.11	2.31	2-3	4.58	2.43	3.58	10.59	7-9	7.01	6-8	1.94	2-3*
220-319	Crocker's Potato, Hop and Tobacco Phos.,	12.52	1.99	2.06-2.88	6.43	2.83	2.84	12.10	10-13	9.26	8-10	3.34	3-4
224-301	New Rival Ammoniated Superphosphate,	16.00	1.41	1.03-2.5	5.44	3.52	1.79	10.75	10-15	8.96	8-12	2.44	2-3
380	Crocker's General Crop Phosphate,	15.40	1.20	.82-1.65	3.84	4.27	1.82	9.93	8-11	8.11	7-9	1.20	1-2
238-400	Crocker's A. A. Complete Manure,	10.76	3.30	3 30-4.12	5.48	4.21	1.41	11.10	9-13	9.69	8-11	7.20	7-8

*Sulphate of Potash, the source of Potash.

II. ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1901, IN THE GENERAL MARKETS BY THE AGENT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
115	Cumberland Superphosphate,	American Agric. Chem. Co. (Cumberland Bone Phos. Co.)	Falmouth.
337	Cumberland Superphosphate,	American Agric. Chem. Co. (Cumberland Bone Phos. Co.)	Lanesboro.
384	Cumberland Superphosphate,	American Agric. Chem. Co. (Cumberland Bone Phos. Co.)	Monson.
118	Cumberland Potato Fertilizer,	American Agric. Chem. Co. (Cumberland Bone Phos. Co.)	Falmouth.
394	Cumberland Potato Fertilizer,	American Agric. Chem. Co. (Cumberland Bone Phos. Co.)	Monson.
17	Darling's Complete Fertilizer,	American Agric. Chem. Co. (L. B. Darling Fert. Co.),	No. Amherst.
216	Potato and Root Crop Manure,	American Agric. Chem. Co. (L. B. Darling Fert. Co.),	Concord.
246	Potato and Root Crop Manure,	American Agric. Chem. Co. (L. B. Darling Fert. Co.),	Wenham.
249	Blood, Bone and Potash,	American Agric. Chem. Co. (L. B. Darling Fert. Co.),	Concord.
289	Blood, Bone and Potash,	American Agric. Chem. Co. (L. B. Darling Fert. Co.),	Leominster.
171	Darling's Potato Manure,	American Agric. Chem. Co. (L. B. Darling Fert. Co.),	Middleboro.
237	Darling's Complete 10% Manure,	American Agric. Chem. Co. (L. B. Darling Fert. Co.),	Wenham.
251	Darling's Complete 10% Manure,	American Agric. Chem. Co. (L. B. Darling Fert. Co.),	Concord.
359	Great Eastern Northern Corn Special,	American Agric. Chem. Co. (Great Eastern Fert. Co),	S. Williamsto'n
338	Great Eastern General Fertilizer,	American Agric. Chem. Co. (Great Eastern Fert. Co.),	S. Williamsto'n
377	Pride of the Valley,	Thomas Kirley & Co., South Hadley Falls, Mass.,	Fairview.
182	Bone Fertilizer for Corn and Grain,	Lowell Fertilizer Co., Boston, Mass.,	Bridgewater.
303	Bone Fertilizer for Corn and Grain,	Lowell Fertilizer Co., Boston, Mass.,	Lowell.
6	Swift's Lowell Animal Brand,	Lowell Fertilizer Co., Boston, Mass.,	Sunderland.
175	Swift's Lowell Animal Brand,	Lowell Fertilizer Co., Boston, Mass.,	W. Wareham.
80	Swift's Lowell Animal Brand,	Lowell Fertilizer Co., Boston, Mass.,	Fall River.
154	Swift's Lowell Animal Brand,	Lowell Fertilizer Co., Boston, Mass.,	Bridgewater.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
115-337-384	Cumberland Superphosphate,	12.29	2.17	2.06-2.88	6.82	2.77	3.10	12.69	10-13	9.59	8-10	2.12	1.5-2.5
118-394	Cumberland Potato Fertilizer,	11.87	2.06	2.06-2.88	5.73	3.51	2.48	11.72	10-13	9.24	8-10	3.60	3-4
17	Darling's Complete Fertilizer,	10.24	2.47	3.30-4.12	7.99	2.75	.52	11.26	9-12	10.74	8-10	7.48	7-8*
216-246	Potato and Root Crop Manure,	8.74	4.34	3.29-4.12	4.80	4.38	.49	9.67	9-12	9.18	8-10	7.44	8-8
249-289	Blood, Bone and Potash,	9.01	3.92	4.12-5.00	3.30	6.32	1.02	10.64	8-11	9.62	7-9	7.52	7-8
171	Darling's Potato Manure,	11.92	2.78	2.48	7.42	3.38	.28	11.08	7	10.80	6	5.38	5
237-251	Darling's Complete 10% Manure,	8.12	3.36	3.30-4.12	3.30	3.28	.84	7.42	7-10	6.58	6-8	9.84	4.32-5.40
359	Great Eastern Northern Corn Special,	13.84	2.88	2.47-3.30	7.04	1.89	2.66	11.59	9-14	8.93	8-12	2.48	2-4
338	Great Eastern General Fertilizer,	13.17	1.21	.82-1.65	5.63	2.53	2.56	10.72	10-14	8.16	8-11	4.10	4-5
377	Pride of the Valley,	12.04	1.78	3.5-4.5	.90	4.81	2.84	8.55	7-9	5.71	—	2.33	4.32-5.40
182-303	Bone Fertilizer for Corn and Grain,	8.59	1.83	1.65-2.5	5.03	3.00	2.20	10.23	9-11	8.03	8-10	3.22	3-4
6-80-154-175	Swift's Lowell Animal Brand,	6.80	2.80	2.47-3.30	6.87	3.69	1.08	11.64	10-12	10.56	9-11	4.26	4-5

*Sulphate of Potash, the source of Potash.

II. ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1901, IN THE GENERAL MARKETS BY THE AGENT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
8	Swift's Lowell Potato Phosphate,	Lowell Fertilizer Co., Boston, Mass.,	Sunderland.
174	Swift's Lowell Potato Phosphate,	Lowell Fertilizer Co., Boston, Mass.,	W. Wareham.
187	Swift's Lowell Potato Phosphate,	Lowell Fertilizer Co., Boston, Mass.,	Hudson.
197	Swift's Lowell Potato Phosphate,	Lowell Fertilizer Co., Boston, Mass.,	Bridgewater.
201	Swift's Lowell Lawn Dressing,	Lowell Fertilizer Co., Boston, Mass.,	Hudson.
253	Swift's Lowell Lawn Dressing,	Lowell Fertilizer Co., Boston, Mass.,	Ayer Junction.
90	Success Fertilizer,	Lister's Agricultural Chemical Works, Newark, N. J.,	Norwood.
122	Success Fertilizer,	Lister's Agricultural Chemical Works, Newark, N. J.,	Fair Haven.
87	High Grade Special for Spring Crops,	Lister's Agricultural Chemical Works, Newark, N. J.,	Norwood.
194	High Grade Special for Spring Crops,	Lister's Agricultural Chemical Works, Newark, N. J.,	Fair Haven.
386	Complete Manure 10% Potash,	Mapes' Formula and Peruvian Guano Co., New York City,	Holyoke.
291	Tobacco Manure (Wrapper Brand),	Mapes' Formula and Peruvian Guano Co., New York City,	Greenfield.
255	Potato Fertilizer,	New England Fertilizer Co., Boston, Mass.,	Harvard.
312	Potato Fertilizer,	New England Fertilizer Co., Boston, Mass.,	Amesbury.
226	Soluble Pacific Guano,	American Agric. Chem. Co. (Pacific Guano Co.),	Georgetown.
318	Soluble Pacific Guano,	American Agric. Chem. Co. (Pacific Guano Co.),	Newburyport.
305	Nobsque Guano,	American Agric. Chem. Co. (Pacific Guano Co.),	Newburyport.
370	Packers' Union Animal Corn Fertilizer,	American Agric. Chem. Co. (Packers' Union Fert. Co.),	S. Williamsto'n
339	Packers' Union Universal Fertilizer,	American Agric. Chem. Co. (Packers' Union Fert. Co.),	S. Williamsto'n
61	Quinnipiac Phosphate,	American Agric. Chem. Co. (Quinnipiac Company),	Seekonk.
183	Quinnipiac Phosphate,	American Agric. Chem. Co. (Quinnipiac Company),	Bridgewater.
361	Quinnipiac Phosphate,	American Agric. Chem. Co. (Quinnipiac Company),	N. Hatfield.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
8-174-187-197	Swift's Lowell Potato Phosphate,	6.32	2.74	2.47-3.30	6.27	1.97	1.87	10.11	9-10	8.24	8-10	6.14	6-7
201-253	Swift's Lowell Lawn Dressing,	8.57	3.62	4.11-4.95	6.50	.90	1.30	8.70	8-10	7.40	7-9	6.46	5-6
90-122	Success Fertilizer,	16.89	1.53	1.24-1.65	5.92	2.67	2.23	10.82	11-13	8.59	9-11	2.54	2-3
87-194	High Grade Special for Spring Crops,	10.83	1.70	1.65-1.80	7.10	1.94	1.89	10.93	10-13	9.04	8-10	10.00	10-10.5
386	Complete Manure 10% Potash,	12.08	2.30	2.06-2.88	2.28	2.64	2.00	6.92	5-7	4.92	3-5	10.34	10-11
291	Tobacco Manure (Wrapper Brand),	6.51	6.36	6.18	—	3.48	2.92	6.40	4.5	3.48	—	10.62	10.5*
255-312	Potato Fertilizer,	4.72	1.84	1.64-2.46	4.35	2.55	1.77	8.67	8-11	6.90	7-9	4.74	4-5*
226-318	Soluble Pacific Guano,	13.44	2.19	2.06-2.88	6.14	2.26	3.68	12.08	10-13	8.40	8-10	1.89	1.5-2.5
305	Nobsque Guano,	17.74	1.17	1.03-2 5	5.35	2.92	2.17	10.44	10 15	8.27	8-12	2.06	2-3
370	Packers' Union Animal Corn Fertilizer,	15.42	2.58	2.47-3.30	7.39	1.69	2.69	11.77	11-14	9.08	9-11	2.14	2-3
339	Packers' Union Universal Fertilizer,	14.26	1.05	.82-1.65	5.37	2.81	2.51	10.69	10-14	8.18	8-11	4.00	4-6
61-183-361	Quinnipiac Phosphate,	13.44	2.62	2.5-3.25	7.14	2.74	1.38	11.26	11-14	9.88	9-11	2.34	2-3

*Sulphate of Potash, the source of Potash.

II. ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1901 IN THE GENERAL MARKETS BY THE AGENT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
35	Quinnipiac Complete Potato Manure,	American Agricultural Chemical Co. (Quinnipiac Co.),	Springfield.
74	Quinnipiac Complete Potato Manure,	American Agricultural Chemical Co. (Quinnipiac Co.),	Seekonk.
30	Quinnipiac Complete Corn Manure,	American Agricultural Chemical Co. (Quinnipiac Co.),	Springfield.
285	Quinnipiac Complete Corn Manure,	American Agricultural Chemical Co. (Quinnipiac Co.),	Harvard.
372	Quinnipiac Complete Corn Manure,	American Agricultural Chemical Co. (Quinnipiac Co.),	Westfield.
26	Quinnipiac Market Garden Fertilizer,	American Agricultural Chemical Co. (Quinnipiac Co.),	Springfield.
37	Quinnipiac Market Garden Fertilizer,	American Agricultural Chemical Co. (Quinnipiac Co.),	Seekonk.
58	Quinnipiac Market Garden Fertilizer,	American Agricultural Chemical Co. (Quinnipiac Co.),	Seekonk.
71	Quinnipiac Market Garden Fertilizer,	American Agricultural Chemical Co. (Quinnipiac Co.),	Fall River.
352	Quinnipiac Market Garden Fertilizer,	American Agricultural Chemical Co. (Quinnipiac Co.),	Westfield.
44	Quinnipiac Potato Phosphate,	American Agricultural Chemical Co. (Quinnipiac Co.),	Fall River.
274	Hubbard's Oats and Top Dressing Fertilizer,	Rogers & Hubbard Co., Middletown, Conn.,	Greenfield.
190	Hubbard's Grass and Grain Fertilizer,	Rogers & Hubbard Co., Middletown, Conn.,	Bridgewater.
252	Hubbard's Grass and Grain Fertilizer,	Rogers & Hubbard Co., Middletown, Conn.,	Harvard.
256	Hubbard's Soluble Potato Manure,	Rogers & Hubbard Co., Middletown, Conn.,	Greenfield.
421	Animal Fertilizer No. 1,	N. Roy & Son, South Attleboro, Mass.,	Amherst.
422	Animal Fertilizer No. 2,	N. Roy & Son, South Attleboro, Mass.,	Amherst.
60	Essex XXX Fish and Potash,	Russia Cement Co., Gloucester, Mass.,	Taunton.
96	Essex XXX Fish and Potash,	Russia Cement Co., Gloucester, Mass.,	Needham.
399	Essex XXX Fish and Potash,	Russia Cement Co., Gloucester, Mass.,	Spencer.
404	Essex XXX Fish and Potash,	Russia Cement Co., Gloucester, Mass.,	Worcester.
72	Essex Potato Fertilizer,	Russia Cement Co., Gloucester, Mass.,	Taunton.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
35-74	Quinnipiac Complete Potato Manure, ...	11.91	2.20	2.5-3.25	5 92	1.45	2.20	9.57	8-11	7.37	6-8	4.48	5-6
30-285-372	Quinnipiac Complete Corn Manure, ...	14.44	2.08	2.06-2.88	5.44	2.44	3.12	11.00	10-13	7.88	8-10	1.72	1.5-2.5
6-37 58-71-352	Quinnipiac Market Garden Fertilizer, ...	10 37	3.18	3.30-4.12	5.03	3.72	1.20	9.95	9-13	8 75	8-11	7·16	7-8
44	Quinnipiac Potato Phosphate, ...	13.86	2.06	2.06-2.88	6.43	2.20	2.81	11.44	10-13	8.63	8-10	3 32	3-4
274	Hubbard's Oats and Top Dressing Fert., ...	3.09	9.09	8.80-9.50	.42	4.32	1.43	6.17	7.85 9	4.74	3.9-4.35	9.70	8.35 9.5
190 252	Hubbard's Grass and Grain Fertilizer, ...	7.92	2.63	2.5-3.00	—	10.16	7.83	17.99	16.5-18	10.16	—	10.96	12.5-13.6
256	Hubbard's Soluble Potato Manure, ...	9.17	5.15	5-6	1.15	7.80	3 02	11.97	10 12	8.95	7-8.5	6 60	5-7
421	Animal Fertilizer No. 1, ...	6.17	3.32	3-4	—	7.92	7.94	15.86	15-16	7.92	7-8	8.72	8 9
422	Animal Fertilizer No. 2, ...	6.12	2.70	2-3	—	8.04	10.38	18.42	18-19	8.04	8-9	3.80	3-4
60-96-399-401	Essex XXX Fish and Potash, ...	13 47	2.44	2.1-3	4.03	4.93	3.58	12.54	12-14	8.96	9-10	2.74	2.25-3.25
72	Essex Potato Fertilizer, ...	11.59	2.24	2-2.5	2.02	7.19	4.53	13.74	11-13	9.21	9-10	5.20	5-6

II. ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1901, IN THE GENERAL MARKETS BY THE AGENT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
360	Essex Special Tobacco Manure,	Russia Cement Company, Gloucester, Mass.,	Sunderland.
19	Complete Potato and Vegetable,	Rogers Manufacturing Co., Rockfall, Conn.,	N. Amherst.
18	High Grade Soluble Tobacco,	Rogers Manufacturing Co., Rockfall, Conn.,	N. Amherst.
346	High Grade Soluble Tobacco,	Rogers Manufacturing Co., Rockfall, Conn.,	S. Deerfield.
299	Read's Standard Superphosphate,	American Agric. Chemical Co. (Read Fertilizer Co.,	Greenfield.
406	Read's Standard Superphosphate,	American Agric. Chemical Co. (Read Fertilizer Co.),	Brookfield.
264	High Grade Farmers' Friend,	American Agric. Chemical Co. (Read Fertilizer Co.),	Greenfield.
356	Read's Vegetable and Vine Fertilizer,	American Agric. Chemical Co. (Read Fertilizer Co.),	S. Deerfield.
241	Original Bay State Bone Superphosphate,	American Agric. Chemical Co. (Henry F. Tucker Co.),	Haverhill.
136	Potato, Onion and Tobacco Manure,	Wilcox Fertilizer Works, Mystic, Conn.,	Dighton.
42	Fish and Potash,	Wilcox Fertilizer Works, Mystic, Conn.,	Fall River.
69	Fish and Potash,	Wilcox Fertilizer Works, Mystic, Conn.,	Seekonk.
45	Complete Bone Superphosphate.	Wilcox Fertilizer Works, Mystic, Conn.,	Fall River.
117	Potato Phosphate,	American Agric. Chem. Co. (Williams & Clark Fert. Co.)	Falmouth.
245	Americus Corn Phosphate,	American Agric. Chem. Co. (Williams & Clark Fert. Co.)	Marlboro.
275	Americus Corn Phosphate,	American Agric. Chem. Co. (Williams & Clark Fert. Co.)	Greenfield.
223	Americus Potato Manure,	American Agric. Chem. Co. (Williams & Clark Fert. Co.)	Marlboro.
250	Americus Potato Manure,	American Agric. Chem. Co. (Williams & Clark Fert. Co.)	Greenfield.
97	Potato Manure,	American Agric. Chem. Co. (M. E. Wheeler & Co.),	Hudson.
330	Corn Fertilizer Success,	E. J. Whitman, Dracut, Mass.,	Amherst.
331	Potato Fertilizer Plowman,	E. J. Whitman, Dracut, Mass.,	Amherst.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.	Guaranteed.
								Found.	Guaranteed.	Found.	Guaranteed.		
	Compound Fertilizers.												
360	Essex Special Tobacco Manure,	7.71	5.24	4.5-5.3	5.73	2.28	1.15	9.16	8.5-9.5	8.01	7-8	10.00	12-13*
19	Complete Potato and Vegetable,	10.17	2.39	2.25-3.25	6.14	3.66	2.23	12.03	10-12	9.80	8-10	4.68	5-6
18-346	High Grade Soluble Tobacco,	5.92	4.85	4.94-5.77	1.28	7.30	1.02	9.60	8-10	8.58	6-8	11.07	11-12*
299-406	Read's Standard Superphosphate,	13.12	.96	.82-1.65	6.12	2.25	3.07	11.44	10-14	8.37	8-11	4.26	4-5
264	High Grade Farmers' Friend,	10.76	3.08	3.30-4.13	5.56	1.68	1.10	8.34	7-10	7.24	6-9	10 00	10-12
356	Read's Vegetable and Vine Fertilizer,	10.34	2.06	2.06-2.88	6.52	2.46	2.30	11.28	10-13	8.98	8-10	6.16	6-7
241	Original Bay State Bone Superphosphate,	13.26	1.99	2.06-2.88	7.20	1.21	2.92	11.33	10-13	8.41	8-10	1.86	1.5-2.5
136	Potato, Onion and Tobacco Manure,	12.28	4.00	3.3-4.30	6.14	2.43	2.15	10.72	8-10	8.57	7-9	6.68	6-7*
42-69	Fish and Potash,	20.40	2.97	2.5-3.5	1.45	4.01	2.81	8.27	6-8	5.46	5-7	3.78	3-4
45	Complete Bone Superphosphate,	15.39	2.61	2-3	6.31	3.41	2.43	12.15	9-12	9.72	8-10	3.94	3-4
117	Potato Phosphate,	11.79	2.33	2.5-3.25	4.41	1.75	2.10	8.26	8-11	6.16	6-8	5.46	5-6
245-275	Americus Corn Phosphate,	12.37	2.06	2.06-2.88	6.43	1.94	4.04	12.41	10-13	8.37	8-10	1.90	1.5-2.5
223-250	Americus Potato Manure,	11.69	2.07	2.06-2.88	5.50	4.40	3.51	13.41	10-13	9.90	8-10	3.18	3-4*
97	Potato Manure,	12.61	2.20	2.06-3.89	6.78	2.17	3.48	12.43	10-13	8.95	8-10	3.18	3-4
330	Corn Fertilizer Success,	6.57	5.11	5-6	.19	5.21	7.04	12.44	12-13	5.40	5-6	6.02	6-7
331	Potato Fertilizer Plowman,	5.87	5.44	5-6	.23	5.65	6.52	12.40	12-13	5.88	5-6	5.28	5-6

*Sulphate of Potash, the source of Potash.

II. ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1901, IN THE GENERAL MARKETS BY THE AGENT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Ground Bones and Tankage.		
324	Abbott's Animal Fertilizer,	W. H. Abbott, Holyoke. Mass.,	Holyoke.
334	Abbott's Animal Fertilizer,	W. H. Abbott, Holyoke, Mass.,	S. Deerfield.
55	Tankage,	Butchers' Rendering Co., Fall River, Mass.,	Fall River.
443	Tankage,†	Butchers' Rendering Co., Fall River, Mass.,	Fall River.
113	Pure Bone Meal,	Thomas Hersom & Co., New Bedford, Mass.,	New Bedford.
156	Meat and Bone	Thomas Hersom & Co., New Bedford, Mass.,	New Bedford.
1	Trainor's Ground Bone,	James P. Trainor, Jamesville, Mass.,	Amherst.
403	Trainor's Ground Bone,	James P. Trainor, Jamesville, Mass.,	Worcester.
328	Pure Ground Bone,	A. L. Warren, Northboro, Mass.,	Northboro.
327	Fine Ground Bone,	Sanford Winter, Brockton, Mass.,	Brockton.
263	Tankage,	J. M. Woodard & Bro., Greenfield, Mass.,	Greenfield.
329	Bone and Meat Meal,	E. J. Whitman, Dracut, Mass.,	Amherst.
332	Fine Ground Bone,	E. J. Whitman, Dracut, Mass.,	Amherst.
	Chemicals.		
341	Prime Cotton Seed Meal,	American Cotton Oil Co., New York City,	Hatfield.
333	Castor Pomace	H. J. Baker & Bro., New York City.,	Whately.

†Collected during the season of 1900.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Mechanical Analysis.			
								Total.		Available.					
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Fine Bone.	Fine Med.	Medium.	Coarse Med.
	Ground Bone and Tankage.														
324-334	Abbott's Animal Fertilizer,	10.79	3.11	3-4	1.47	11.66	6.93	20.06	17-19	13.13	15-17	32.62	29.00	22.19	16.19
55	Tankage,	11.02	5.37	5-6	—	7 60	10.57	18.17	18-20	7.60	7-8	7.27	20.47	26.18	46.08
443	Tankage,†	4.65	5.56	5-6	—	8.84	8.00	16.84	16-18	8.84	7-8	31.68	41.68	12.34	14.30
113	Pure Bone Meal,	3-16	2.17	1.46	—	14.15	14.97	29.12	28.28	14.15	6.78	37.63	36.91	12.40	13.06
156	Meat and Bone,	3.97	5.02	2-4.24	—	7.53	10.87	18.40	19.52	7.53	6.73	60.16	26.58	9.26	4.00
1-403	Trainor's Ground Bone,	4.63	1.84	1-2	—	—	—	27.76	27-28	—	—	30.04	36.27	19.64	14.05
328	Pure Ground Bone,	8.60	3.71	3.70	—	13.70	9.08	22.78	22.72	13.70	—	13.57	57.91	18.91	9.61
327	Fine Ground Bone,	5.50	3.92	3.5-4	—	15.46	4.36	19.82	19-20	15.46	—	11.62	42.73	40.22	5.43
263	Tankage,	5.62	5.27	5-6	—	12.08	7.85	19.93	19-20	12.08	—	40.99	15.65	14.62	28.74
329	Bone and Meat Meal,	6.46	5.15	5-6	—	6.28	10.10	16.38	16-18	6.28	6-8	50.67	30.89	14.65	3.79
332	Fine Ground Bone,	3 94	1.67	1.5-2.00	—	7.62	22.64	30.26	30-31	7.62	7-8	53.69	33.84	9.00	3.47
	Chemicals.														
341	Prime Cotton Seed Meal,	5.88	6.82	7	—	—	—	—	—	—	—				
333	Castor Pomace,	7.69	4.98	4.74-5.77	—	—	—	2.30	—	—	—				

†Collected During season of 1900.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	1901 Cents per pound
Nitrogen in ammonia salts,	16.5
" nitrates,	14.0
Organic nitrogen in dry and fine ground fish, meat, blood, and in high-grade mixed fertilizers,	16.0
" " " fine bone and tankage,	16.0
" " " medium bone and tankage,	12.0
Phosphoric acid soluble in water,	5.0
" " soluble in ammonium citrate,	4.5
" " in fine ground fish, bone and tankage,	4.0
" " in cottonseed meal, castor pomace and wood ashes,	4.0
" " in coarse fish, bone and tankage,	3.0
" " insoluble (in water and in am. cit.) in mixed fertilizers,	2.0
Potash as Sulphate, free from Chlorides,	5.0
" " Muriate,	4.25

The market value of low priced materials used for manurial purposes, as salt, wood ashes, various kinds of lime, barnyard manure, factory refuse and waste materials of different description, quite frequently does not stand in close relation to the current market value of the amount of essential articles of plant food they contain. Their cost varies in different localities. Local facilities for cheap transportation and more or less advantageous mechanical conditions for a speedy action, exert as a rule, a decided influence on their selling price.

Valuation. The approximate value of a compound fertilizer or any material used for fertilizing purposes is obtained by calculating the value of each of the three essential elements of plant food (nitrogen, phosphoric acid and potassium oxide, including the different forms of each wherever different forms are recognized in the table), in one hundred pounds of the fertilizer and multiply each product by twenty to change it to a ton basis. The sum of these values will give the total approximate value of the fertilizer per ton at the principal places of distribution.

HATCH EXPERIMENT STATION

—OF THE—

MASSACHUSETTS

AGRICULTURAL COLLEGE.

BULLETIN NO. 76.

THE IMPORTED ELM LEAF-BEETLE.

JULY, 1901.

AMHERST, MASS.:
PRESS OF CARPENTER & MOREHOUSE,
1901.

HATCH EXPERIMENT STATION

OF THE

Massachusetts Agricultural College,

AMHERST, MASS.

STATION STAFF:

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WILLIAM P. BROOKS, PH. D.,	*Agriculturist.*
GEORGE E. STONE, PH. D.,	*Botanist.*
CHARLES A. GOESSMANN, PH. D., LL. D.,	*Chemist* (Fertilizers).
JOSEPH B. LINDSEY, PH. D.,	*Chemist* (Foods and Feeding).
CHARLES H. FERNALD, PH. D.,	*Entomologist.*
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J. E. OSTRANDER, C. E.,	*Meteorologist.*
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HATCH EXPERIMENT STATION, Amherst, Mass.

DIVISION OF ENTOMOLOGY.

H. T. FERNALD.

THE IMPORTED ELM LEAF-BEETLE.

Galerucella luteola Mull.

During the present summer much injury to the elms in this State has been caused by the Imported Elm Leaf-Beetle, and as it is to these trees that Massachusetts owes much of its beauty, many inquiries have been received as to the life history of this insect and the treatment necessary for its control.

HISTORY.

This insect is a native of Southern Europe though sometimes found as far north as England and Sweden. It appears to have reached this country at Baltimore, about 1835, since which time it has slowly spread in all directions, though checked in its westward progress by the Appalachian ranges. It probably reached southwestern Massachusetts in 1892 or 1893 as it was found in Amherst in 1895. Since then it has gradually spread until it has become abundant over the entire State.

LIFE HISTORY.

The elm leaf-beetle passes the winter as the adult beetle (Fig 1, *c* and *k*), hiding wherever it can find protection. House attics, unused chimneys, church towers, barns and other places easy of access appear in this locality to be preferred to cracks in fences, crevices in the bark of trees, etc., for the purpose.

In the spring the beetles leave their hiding places about the time the leaf buds open, and after mating, feed upon the tender leaves, making irregular holes. When the leaves become full grown egg laying begins, each female depositing from 400 to 600 eggs. These

are yellow and are placed on the lower side of the leaves, usually in about two irregular rows close together, and from five to twenty-six in number. After depositing a cluster the adult beetle feeds for a longer or shorter time before again depositing, and in this way the period of egg laying is not only extended over a considerable time, but the injury caused by the beetle feeding is correspondingly increased.

The eggs (Fig. 1, *a* and *e*) are oval in form, attached by one end, and somewhat pointed at the tip. They hatch in less than a week after they are laid, and as egg laying continues for quite a period, eggs and young more than half grown, may often be found on the same tree.

The young larvae or grubs (Fig. 1, *b*, *g*,) feed on the under surfaces of the leaves leaving the upper surfaces and veins entire, thus skeletonizing the leaf. They complete their growth in from fifteen to twenty days at which time they are about a third of an inch in length, with a black head and a yellowish body with a black stripe extending on each side of the middle line of the body, from the head to the posterior end where the stripes unite. The larvae now stop feeding and crawl down the trunk until some crevice is found in which the next stage may be passed, or continue to the ground at the foot of the tree. In some cases they drop from the limbs instead of passing down the trunk. As soon as a satisfactory spot has been found, the grub changes to a pupa (Fig. 1, *j*) and in this condition remains quiet for a week or ten days, after which the adult beetle escapes from the pupa, to lay eggs for a second brood, the history of which is the same as that of the first brood, just described, except that the adults of the second brood hide during the winter and lay their eggs the following spring.

During the present year egg clusters were abundant by the fifteenth of June and most of the grubs had completed their feeding and had begun to crawl down the tree by the twelfth of July, though two weeks later a few belated individuals were still making their way downward, while beetles to lay eggs for the second brood were beginning to appear, coming from the grubs which were first to pupate.

The adult beetle (Fig. 1, *k*) is rather more than a quarter of an inch long, greenish or sometimes reddish yellow in color, with two black eyes and a black spot between them, on the head, three black

spots on the thorax, and a broad blackish stripe along the back on each side. Between these stripes the yellow ground color is divided by a very narrow black line which runs along the middle of the back where the wing covers meet. At the front end of the two strips of yellow on the back is a black spot. Altogether the beetle somewhat resembles a large Striped Cucumber Beetle.

G. 1.—THE ELM LEAF-BEETLE: *a*, eggs; *b*, larvae; *c*, adult; *e*, eggs; *g*, larva; *j*, pupa; *k*, beetle; *a*, *b* and *c*, natural size; *e*, *g*, *j* and *k*, much enlarged.—From U. S. Department of Agriculture.

FOOD PLANTS.

The food of the elm leaf-beetle seems to be limited to the elm though it has been known to deposit its eggs on one or two other plants, perhaps under exceptional conditions. Among the elms the English elm *Ulmus campestris* and its variety the Camperdown elm are most preferred, though after the pest has become established the American elm *Ulmus americana* is also attacked.

TREATMENT.

Where this insect is abundant, treatment for it is necessary if the elms are to be preserved. Generally speaking, a tree will suffer defoliation once or even twice without being killed, but if defoliated three times in succession serious injury at least, if not death, must be the result.

Spraying is undoubtedly the best way to check the attacks of the elm leaf-beetle, and the cost is much less than might be supposed. The spraying should be done first when the leaves are partly grown in spring, as at this time the beetles which have wintered over feed on the leaves for some time before laying their eggs as well as during the intervals between the deposition of the different clusters. This treatment will destroy many, at least, of the beetles, which would otherwise produce young to do damage later in the season.

A second spraying will often be necessary however, soon after the eggs hatch, and as the young grubs feed on the under side of the leaves, not eating the upper surface, the aim should be to spray so that the poison may reach the under surface of the leaves as far as possible.

If these treatments have been neglected, or for any reason have proved inefficient, the insects may be attacked while on the trunk and ground where they are more accessible than when scattered over the tree. At this time however, the damage has already been done and by destroying the insects at this time only the size of the following brood will be reduced. Still, this is well worth doing with a view to protecting the trees from another attack while still in a weakened condition.

For the same reason the destruction of all the beetles found in hiding during the winter, is extremely desirable.

In spraying the trees Paris green or arsenate of lead may be used, the latter being preferable as it does not burn the leaves at any strength when properly prepared. For destroying the insects on the trunk and ground boiling water is excellent, but as it is often impossible to get it to the trees sufficiently hot, kerosene emulsion or the mechanical mixture of kerosene and water may be found more convenient for use.

SPRAYING MIXTURES FOR THE ELM LEAF-BEETLE.

ARSENATE OF LEAD.

Arsenate of Soda,	4 oz.
Acetate of Lead,	11 oz.
Water,	100 gallons.

Mix together and it is ready for use.

PARIS GREEN.

Paris green,	1 lb.
Quick lime,	2 lbs.
Water,	100 gallons.

Slack the lime in part of the water and gradually add the Paris green: then add the rest of the water.

KEROSENE EMULSION.

Hard soap shaved fine,	1-2 lb.
Water (soft),	1 gallon.
Kerosene,	2 gallons.

Dissolve the soap in the water, boiling; remove from the fire, pour in the kerosene and churn with the spray pump till it becomes, first creamy, then soft and butter like. One part of this mixed with five parts of soft water should be sufficiently strong to accomplish the desired purpose.

During the present summer a soap powder known as Laundry Chips has been used in Amherst with good success, prepared as follows:

"Laundry Chips,"	2 lbs.
Kerosene,	8 gallons.
Water,	35 gallons.

This was prepared with hot water and churned upon adding the kerosene as in the directions above.

KEROSENE AND WATER MIXTURE.

This mixture is made entirely by the pump which consists of two tanks so connected that the operator may fix at will the proportion of the fluids to each other. For the elm leaf-beetle the proportion should be 1 of kerosene to 3 of water.

SUMMARY.

1. Spray the tree with Arsenate of lead or Paris green when the leaves are about half grown in spring.
2. Repeat this treatment soon after the eggs hatch—usually about the first week in June but varying with the season and locality.
3. Remove all loose bark on the trunk and main limbs of the tree, that the grubs may find no place to pupate in, and so go to the base of the tree.
4. Destroy the grubs and pupæ at the base of the tree with boiling water, kerosene emulsion or the kerosene and water mixture, and repeat after five days if necessary.
5. Destroy all beetles found in hiding during the winter.

HATCH EXPERIMENT STATION

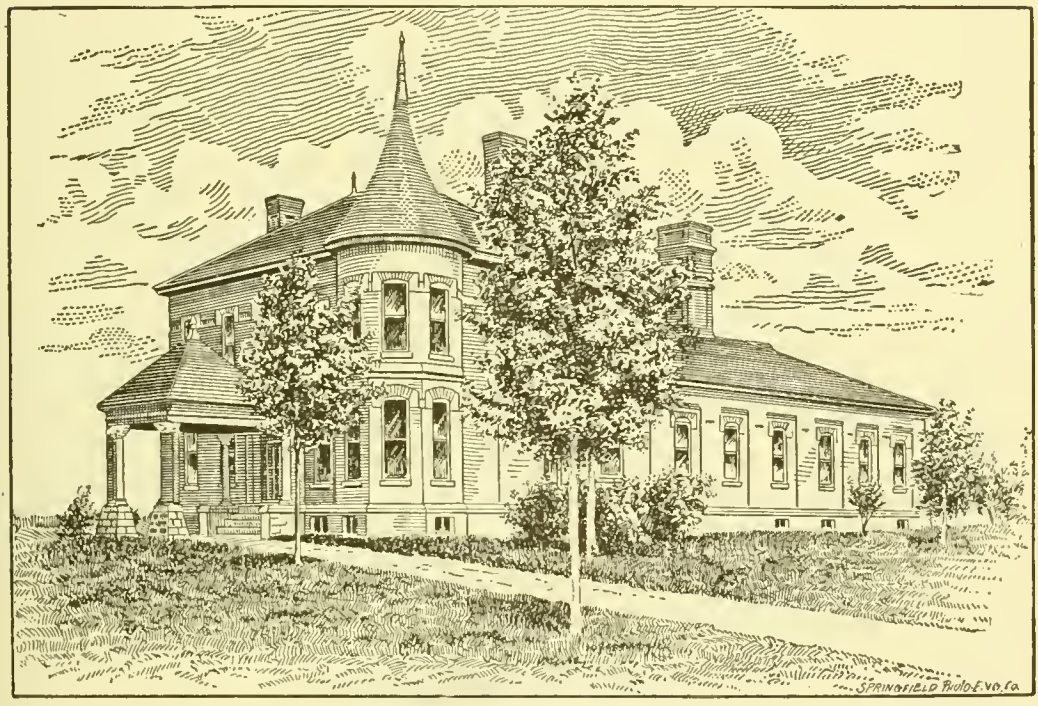
—OF THE—

MASSACHUSETTS AGRICULTURAL COLLEGE.

BULLETIN NO. 77.

I. ANALYSES OF MANURIAL SUBSTANCES SENT ON FOR EXAMINATION.

II. ANALYSES OF LICENSED FERTILIZERS COLLECTED BY THE AGENT OF THE STATION DURING 1901.



CHEMICAL LABORATORY.

NOVEMBER, 1901.

The Bulletins of this Station will be sent free to all newspapers in the State and to such individuals interested in farming as may request the same.

AMHERST, MASS.:
PRESS OF CARPENTER & MOREHOUSE,
1901.

HATCH EXPERIMENT STATION

OF THE

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AMHERST, MASS.

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George E. Stone, Ph. D.,	*Botanist.*
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Hatch Experiment Station, Amherst, Mass.

DIVISION OF CHEMISTRY.

C. A. Goessmann.

I.

ANALYSES OF COMMERCIAL FERTILIZERS AND MANURIAL SUBSTANCES SENT ON FOR EXAMINATION.

WOOD ASHES.

960-964. I. Received from Concord, Mass.
II. Received from North Hatfield, Mass.
III. Received from Concord, Mass.
IV. Received from Southwick, Mass.
V. Received from Amherst, Mass.

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	14.12	3.96	17.56	11.36	2.72
Potassium oxide,	5.16	3.56	4.77	5.88	5.31
Phosphoric acid,	1.54	1.28	1.59	1.89	4.58
Calcium oxide,	30.42	27.42	31.97	31.54	29.48
Insoluble matter,	—	25.69	9.64	16.19	19.57

965-969.
I., II. and III. Received from Amherst, Mass.
IV. Received from North Amherst, Mass.
V. Received from Springfield, Mass.

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	16.22	13.82	24.14	8.22	2.62
Potassium oxide,	6.50	4.74	3.52	4.38	6.80
Phosphoric acid,	1.15	1.71	1.36	1.56	1.87
Calcium oxide,	32.28	28.87	25.56	39.05	32.97
Insoluble matter,	9.34	16.59	10.72	5.41	13.84

970-974. I. Received from Springfield, Mass.
II. Received from Boston, Mass.
III. Received from Concord, Mass.
IV. and V. Received from Hadley, Mass.

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	2.12	20.12	12.85	6.79	8.60
Potassium oxide,	4.66	6.56	5.40	5.44	5.04
Phosphoric acid,	1.54	1.58	1.33	1.38	1.25
Calcium oxide,	37.78	29.48	29.14	34.84	30.24
Insoluble matter,	5.96	33.56	14.83	15.69	18.76

975-979. I. Received from South Deerfield, Mass.
II., III. and IV. Received from Sunderland, Mass.
V. Received from Beverly, Mass.

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	20.55	20.30	7.78	21.29	19.01
Potassium oxide,	1.16	3.96	6.24	4.40	5.00
Phosphoric acid,	.64	1.41	1.64	1.87	.97
Calcium oxide,	43.50	29.74	44.70	30.98	35.44
Insoluble matter,	3.91	15.02	5.63	10.06	6.69

980-984. I. and II. Received from Asylum, Mass.
III. Received from Hadley, Mass.
IV. Received from Easthampton, Mass.
V. Received from Westfield, Mass.

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	14.06	11.34	.12	11.28	5.26
Potassium oxide,	5.77	5.00	9.60	5.06	5.51
Phosphoric acid,	1.69	1.64	1.36	1.43	2.20
Calcium oxide,	28.08	28.52	42.73	27.09	26.21
Insoluble matter,	16.92	18.80	7.88	9.13	19.76

985-989. I. Received from Concord, Mass.
II. and III. Received from South Amherst, Mass.
IV. Received from Fitchburg, Mass.
V. Received from Millis, Mass.

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	11.29	17.23	17.45	27.04	10.46
Potassium oxide,	4.71	4.65	3.48	5.26	6.60
Phosphoric acid,	1.41	1.38	1.07	1.30	1.30
Calcium oxide,	30.68	24.60	18.86	25.58	32.06
Insoluble matter,	13.50	11.42	10.47	5.81	14.89

COTTON HULL ASHES.

990-992. I. Received from Southwick, Mass.
II. Received from Sunderland, Mass.
III. Received from Springfield, Mass.

	Per Cent. I.	II.	III.
Moisture at 100° C.,	2.90	10.77	2.20
Potassium oxide,	20.36	25.48	21.04
Phosphoric acid,	6.76	7.29	4.86
Calcium oxide,	*	9.37	16.16
Sulphuric acid,	*	4.12	10.50
Insoluble matter,	16.85	9.46	16.56

MISCELLANEOUS ASHES.

993-995. I. Walnut Ashes, received from Boston, Mass.
II. Pine Wood Ashes, received from Hanover, Mass.
III. Ashes from Soft Coal and Sawdust, received from Shirley, Mass.

	Per Cent. I.	II.	III.
Moisture at 100° C.,	3.79	2.76	3.36
Potassium oxide,	5.06	4.37	.73
Phosphoric acid,	2.07	3.07	.74
Calcium oxide,	40.73	23.61	2.80
Insoluble matter,	2.29	37.46	69.53

MURIATE OF POTASH.

996-1001. I. Received from Hudson, Mass.
II. Received from Longmeadow, Mass.
III. Received from Hudson, Mass.
IV. and V. Received from Concord, Mass.
VI. Received from Seekonk, Mass.

	Per Cent. I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	2.25	.37	2.31	1.71	.32	2.54
Potassium oxide,	51.72	48.10	50.76	50.80	51.70	46.60

NITRATE OF SODA.

1002-1005. I. Received from Hudson, Mass.
II. and III. Received from Longmeadow, Mass.
IV. Received from Hudson, Mass.

* Not determined.

	Per Cent. I.	II.	III.	IV.
Moisture at 100° C.,	1.82	1.09	.34	2.11
Nitrogen,	15.07	16.08	15.37	16.57

COTTON SEED MEAL AND TOBACCO STEMS.

1006-1010.

I. and II. Cotton Seed Meal, received from Agawam, Mass.
III. Cotton Seed Meal, received from Sunderland, Mass.
IV. Cotton Seed Meal, received from Feeding Hills, Mass.
V. Tobacco Stems, received from Hudson, Mass.

	Per Cent. I.	II.	III.	IV.	V.
Moisture at 100° C.,	6.26	6.15	9.11	7.83	11.70
Nitrogen,	7.02	7.27	6.98	6.69	1.99
Potassium oxide,	*	*	*	*	8.68
Phosphoric acid,	*	*	*	*	1.02

GROUND BONE, TANKAGE, FISH AND BLOOD, MEAT AND BONE.

1011-1014. I. Ground Bone, received from Jamesville, Mass.
II. Tankage, received from Concord, Mass.
III. Tankage, received from North Hatfield, Mass.
IV. Ground Fish, received from Hatfield, Mass.

	Per Cent. I.	II.	III.	IV.
Moisture at 100° C.,	4.63	16.73	6.11	7.54
Total Phosphoric acid,	27.76	12.05	11.67	7.68
Available Phosphoric acid,	*	6.98	2.15	*
Insoluble Phosphoric acid,	*	5.07	9.52	*
Nitrogen,	1.84	6.47	5.36	8.23

1015-1018. I. Ground Fish, received from Hatfield, Mass.
II. and III. Blood, Bone and Meat, received from New Lenox, Mass.
IV. Dry Ground Blood, received from Stoneham, Mass.

	Per Cent. I.	II.	III.	IV.
Moisture at 100° C.,	8.26	7.62	4.45	14.34
Total Phosphoric acid,	6.70	7.16	10.77	trace
Available Phosphoric acid,	*	4.01	4.32	*
Insoluble Phosphoric acid,	*	3.15	6.45	*
Nitrogen,	7.80	7.38	6.25	13.75

*Not determined.

PHOSPHORIC ACID COMPOUNDS.

1019-1021.

I. Dissolved Bone Black, received from New Lenox, Mass.
II. Superphosphate, received from New Lenox, Mass.
III. Dissolved Bone Black, received from Westboro, Mass.

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	13.70	11.17	12.09
Total Phosphoric acid,	17.76	15.10	16.84
Soluble Phosphoric acid,	14.84	9.83	13.43
Reverted Phosphoric acid,	2.54	4.20	2.46
Insoluble Phosphoric acid,	.38	1.07	.95

LIME COMPOUNDS.

1022-1023.

I. Carbonate of Lime, received from Greenfield, Mass.
II. Waste from Gas House, received from Boston, Mass.

	Per Cent.	
	I.	II.
Moisture at 100° C.,	.44	.04
Calcium oxide,	51.65	53.29
Sulphuric acid,	none	18.60
Insoluble matter,	*	.58

COMPLETE FERTILIZERS.

1024-1027. I., II. and III. Received from Southboro, Mass.
IV. Received from Sunderland, Mass.

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	9.49	12.49	5.97	7.87
Total Phosphoric acid,	4.99	5.40	10.26	10.36
Soluble Phosphoric acid,	—	3.36	5.50	3.84
Reverted Phosphoric acid,	3.74	1.50	2.74	3.84
Insoluble Phosphoric acid,	1.25	.54	2.02	2.68
Potassium oxide,	6.78	6.20	6.08	6.08
Nitrogen,	4.28	1.54	3.10	3.48

1028-1032. I. Received from Sunderland, Mass.
II. and III. Received from Southwick, Mass.
IV. Received from Shelburne Falls, Mass.
V. Received from Enfield, Mass.

* Not determined.

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	6.20	14.07	7.87	7.09	4.93
Total Phosphoric acid,	13.18	10.42	10.62	9.08	3.91
Soluble Phosphoric acid,	1.98	5.20	2.30	4.94	—
Reverted Phosphoric acid,	10.18	3.18	4.62	2.50	1.95
Insoluble Phosphoric acid,	1.02	2.04	3.70	1.64	1.96
Potassium oxide,	6.92	5.08	7.92	9.66	15.42
Nitrogen,	3.35	2.09	3.22	4.50	6.34

1033-1037. I., II., III. and IV. Received from Granby, Mass.
V. Received from Hatfield, Mass.

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	9.51	9.26	10.68	11.88	8.10
Total Phosphoric acid,	9.75	8.96	8.01	8.26	4.35
Soluble Phosphoric acid,	6.91	4.52	.93	.83	1.77
Reverted Phosphoric acid,	1.41	2.57	3.73	3.34	2.17
Insoluble Phosphoric acid,	1.43	1.87	3.35	4.09	.41
Potassium oxide,	5.42	6.66	2.60	4.02	5.02
Nitrogen,	3.52	2.94	4.50	1.72	4.66

1038-1041. I. Received from Sunderland, Mass.
II. and III. Received from North Hatfield, Mass.
IV. Received from Ipswich Beach, Mass.

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	2.85	8.96	5.45	21.57
Total Phosphoric acid,	9.34	11.03	10.39	8.23
Soluble Phosphoric acid,	2.17	2.75	2.28	4.48
Reverted Phosphoric acid,	6.07	5.58	2.28	1.96
Insoluble Phosphoric acid,	1.10	2.70	5.83	1.79
Potassium oxide,	15.30	3.71	5.16	10.04
Nitrogen,	—	5.13	4.44	2.40

MUCK AND MARL.

1042-1045.

I. Muck from Salt Marsh, received from Mattapoisett, Mass.
II. Mud, received from Cummington, Mass.
III. and IV. Muck, received from Millington, Mass.

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	78.22	48.83	82.45	81.43
Ash,	—	44.78	1.18	1.13
Nitrogen,	.33	.21	.31	.22
Phosphoric acid,	.04	trace	trace	trace
Calcium oxide,	.18	none	trace	trace

1046-1048. I. Muck, received from Boston, Mass.
II. Mud, received from South Boston, Mass.
III. Marl (so called), received from Millington, Mass.

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	78.10	15.28	15.54
Ash,	16.00	59.28	—
Nitrogen,	.16	.65	.001
Phosphoric acid,	trace	trace	.02
Potassium oxide,	*	*	.29
Calcium oxide,	trace	trace	trace

SOILS.

1049-1054.

I. River Sediment, received from Clinton, Mass.
II. Soil, received from Arlington, Mass.
III. Soil, received from Ashfield, Mass.
IV. Soil, received from Osterville, Mass.
V. Soil, received from Somerville, Mass.
VI. Salt Marsh Soil, received from West Tisbury, Mass.

	Per Cent.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	53.48	2.38	31.99	66.85	1.69	18.71
Nitrogen,	.25	.49	.93	.61	.30	.002
Phosphoric acid,	.12	.32	.82	.09	*	*
Potassium oxide,	.28	.13	.38	.06	*	*
Calcium oxide,	*	trace	2.04	trace	*	trace

* Not determined.

II. ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1901 IN THE GENERAL MARKETS BY THE AGENT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
218	Ammoniated Bone and Potash,	Armour Fertilizer Works, Baltimore, Md.,	Harvard.
286	Ammoniated Bone and Potash,	Armour Fertilizer Works, Baltimore, Md.,	Danvers.
283	All Soluble,	Armour Fertilizer Works, Baltimore, Md.,	Danvers.
325	Abbott's Eagle Brand,	W. H. Abbott, Holyoke, Mass.,	Amherst.
349	Ammoniated Bone Phosphate,	Berkshire Fertilizer Company, Bridgeport, Conn.,	Pittsfield.
259	Dry Ground Fish,	American Agricultural Chemical Co., Boston, Mass.,	Greenfield.
365	Dry Ground Fish,	American Agricultural Chemical Co., Boston, Mass.,	No. Hatfield.
50	Complete Potato Manure,	American Agric. Chem. Co. (H. J. Baker & Bro., N. Y.),	Fall River.
119	Complete Potato Manure,	American Agric. Chem. Co. (H. J. Baker & Bro., N. Y.),	Falmouth.
416	Complete Potato Manure,	American Agric. Chem. Co. (H. J. Baker & Bro., N. Y.),	Worcester.
102	Canada Unleached Hardwood Ashes,	Bowker Fertilizer Company, Boston, Mass.,	Boston.
323	Canada Unleached Hardwood Ashes,	Bowker Fertilizer Company, Boston, Mass.,	Danvers.
23	Farm and Garden Phosphate,	Bowker Fertilizer Company, Boston, Mass,,	Springfield.
31	Market Garden Fertilizer,	Bowker Fertilizer Company, Boston, Mass.,	Springfield.
39	Market Garden Fertilizer,	Bowker Fertilizer Company, Boston, Mass.,	Seekonk.
47	Fish and Potash, "D" Brand,	Bowker Fertilizer Company, Boston, Mass.,	Fall River.
139	Bristol Fish and Potash,	Bowker Fertilizer Company, Boston, Mass.,	Dighton.
25	Tobacco Starter,	Bowker Fertilizer Company, Boston, Mass.,	Springfield.
295	Bowker's Potash or Staple Phosphate,	Bowker Fertilizer Company, Boston, Mass.,	Bernardston.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
218-286	Ammoniated Bone and Potash,	10.91	2.68	2.47-3.30	2.41	4.91	3.12	10.44	8-10	7.32	6 9	2.19	2-3
283	All Soluble,	6.47	3.12	2.88-3.70	1 54	7.21	3.43	12.18	10-12	8.75	8-12	5.01*	4-5
325	Abbott's Eagle Brand,	12.72	2.25	3-4	1.51	10.59	2.46	14.56	14-15	12.10	12-14	12.87*	10-11
349	Ammoniated Bone Phosphate,	6.70	1.46	.82-1.65	3.94	2.47	3.06	9.47	10-12	6.41	8-10	3.62*	2-3
259-365	Dry Ground Fish,	9.79	9.19	8.27-9.	—	3.22	4.48	7.70	7-9	3.22	—	—	—
50-119-416	Complete Potato Manure,	10.18	2.94	3.30-4.12	4.26	3.77	3.30	11.33	7-12	8.03	6-10	10.00	10 12
102-323	Canada Unleached Hard Wood Ashes,	17.59	—	—	—	—	—	1.59	1-3	—	—	5.74	4-7
23	Farm and Garden Phosphate,	17.05	1.96	1.50-2.50	5.95	2.96	1.89	10.80	11-14	8.91	8-11	2.33	2-3
31-39	Market Garden Fertilizer,	12.65	2.38	2.25-3.25	5.25	1.50	1.23	7.98	7-10	6.75	6-8	10.54	10-12
47	Fish and Potash "D" Brand,	10.85	2.70	2.25-3.25	1.73	5.61	2.61	9.95	8-10	7.34	6-8	1.82	2-4
139	Bristol Fish and Potash,	16.49	1.66	1.5-2.5	5.69	2.70	1.84	10.23	8-10	8.39	5-8	2.14	2-3
25	Tobacco Starter,	8.56	2.58	2.25-3.25	4.96	4.55	3.74	13.25	10-12	9.51	8-10	4.18*	3-4
295	Bowker's Potash or Staple Phosphate,	12.84	.84	.75-1.50	3.39	3.49	3.58	10.46	10-12	6.88	8-10	3.00	3-4

*Sulphate of potash the source of Potash.

II. ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1901, IN THE GENERAL MARKETS BY THE AGENT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
27	Special Fertilizer for Corn, Grain, etc.,	Bowker Fertilizer Company, Boston, Mass.,	Springfield.
145	Early Potato Manure.	Bowker Fertilizer Company, Boston, Mass.,	Dighton.
233	Early Potato Manure,	Bowker Fertilizer Company, Boston, Mass.,	Leominster.
314	Ammoniated Dissolved Bone,	Bowker Fertilizer Company, Boston, Mass.,	Lawrence.
210	Potato and Vegetable Phosphate,	Bowker Fertilizer Company, Boston, Mass.	Bernardston.
81	Church's Fish and Potash,	American Agric. Chem. Co. (Bradley Fert. Co.) Boston,	Weir.
130	Church's Fish and Potash,	American Agric. Chem. Co. (Bradley Fert. Co.) Boston,	New Bedford.
116	Grass and Lawn Top Dressing,	American Agric. Chem. Co. (Bradley Fert. Co.) Boston,	New Bedford.
191	Grass and Lawn Top Dressing,	American Agric. Chem. Co. (Bradley Fert. Co.) Boston,	Bridgewater.
82	Brightman's Fish and Potash,	American Agric. Chem. Co. (Bradley Fert. Co.) Boston,	Whittenton.
101	Brightman's Fish and Potash,	American Agric. Chem. Co. (Bradley Fert. Co.) Boston,	Needham.
125	Brightman's Fish and Potash,	American Agric. Chem. Co. (Bradley Fert. Co.) Boston,	New Bedford.
265	Niagara Phosphate,	American Agric. Chem. Co. (Bradley Fert. Co.) Boston,	Ayer Junction.
15	Complete Fertilizer for Corn and Grain,	American Agric. Chem. Co. (Bradley Fert. Co.) Boston,	Sunderland.
28	English Lawn Fertilizer,	American Agric. Chem. Co. (Bradley Fert. Co.) Boston,	Springfield.
193	English Lawn Fertilizer,	American Agric. Chem. Co. (Bradley Fert. Co.) Boston,	Needham.
164	Complete Manure with 10 per cent Potash,	American Agric. Chem. Co. (Bradley Fert. Co.) Boston,	Boston.
409	Complete Manure for Top Dressing,	American Agric. Chem. Co. (Bradley Fert. Co.) Boston,	Worcester.
86	Grass Fertilizer,	Amer. Agric. Chem. Co. (Clark's Cove Fert. Co.) Boston,	Hudson.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
27	Special Fertilizer for Corn, Grain, etc.,	8.97	2.52	1.75-2.75	6.18	3.49	2.89	12.56	12-14	9.67	6-8	4.00	4-6
145-233	Early Potato Manure,	10.23	3.11	3-4	4.35	3.15	2.94	10.44	9-11	7.50	7-9	7.17	7-9
314	Ammoniated Dissolved Bone,	14.51	1.52	1.5-2.5	6.91	1.82	1.02	9.75	10-12	8.73	8-10	2.40	2-3
210	Potato and Vegetable Phosphate,	16.29	1.52	1.5-2.5	7.20	2.04	1.61	10.85	11-13	9.24	9-11	2.30	2-4
81-130	Church's Fish and Potash,	14.11	2.07	2.07-2.9	2.92	3.64	2.70	9.26	7.5-10.5	6.56	6-8	2.70	2-3
116-191	Grass and Lawn Top Dressing,	9.73	3.82	3.91-4.73	2.37	3.79	1.23	7.39	6-9	6 16	5-7	2.50*	2-3
82-101-125	Brightman's Fish and Potash,	14.63	2.46	2.06-2.90	2.47	4.42	2.81	9.70	7.5-10.5	6.89	6-8	2.66	2-3
265	Niagara Phosphate,	14.41	1.39	.82-1.65	4.26	3.14	2.96	10.36	8-11	7.40	7-9	1.24	1-2
15	Complete Fertilizer for Corn and Grain,	10.23	3.38	3.30-4.12	4.93	3.80	5 78	14.51	13-16	8.73	12-14	2.53	3-4
28-193	English Lawn Fertilizer,	8.41	5.47	4.95-5.78	2.56	3.12	1 38	7.06	6-9	5.68	5 7	3.14*	2.5-3.5
164	Complete Manure with 10 per cent Potash,	8.22	3.35	3.30-4.13	3.04	2.85	1.94	7.83	7-10	5.89	6-10	10.31	10-12
409	Complete Manure for Top Dressing,	7.85	5.46	4.95-5.78	1.85	3.55	1.23	6.63	6-8	5.40	5-7	2.83*	2.5-3.5
86	Grass Fertilizer,	9.08	4.19	3.91-4.73	2.72	2.44	1.36	6.52	6-9	5.16	5-7	2.44*	2-3

*Sulphate of Potash the source of Potash.

II. ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1901, IN THE GENERAL MARKETS BY THE AGENT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
126	Potato Manure,	American Agric. Chem. Co. (Clark's Cove Fertilizer Co.)	Falmouth.
208	Great Planet Manure,	American Agric. Chem. Co. (Clark's Cove Fertilizer Co.)	Winchendon.
228	Columbian Bone Superphosphate,	E. Frank Coe Co., New York City,	Haverhill.
68	American Farmers' Market Garden Special,	E. Frank Coe Co., New York City,	Seekonk.
138	American Farmers' Market Garden Special,	E. Frank Coe Co., New York City,	Dighton.
150	American Farmers' Complete Potato Manure,	E. Frank Coe Co., New York City,	Dighton.
262	Farmers' Grass and Grain Fertilizer,	E. Frank Coe Co., New York City,	Winchendon.
335	Americus Corn Phosphate,	American Agric. Chem. Co. (Crocker Fert. & Chem. Co.)	Haverhill.
410	Americus Corn Phosphate,	American Agric. Chem. Co. (Crocker Fert. & Chem. Co.)	Worcester.
124	Darling's Farm Favorite,	American Agric. Chem. Co. (L. R. Darling Fert. Co.),	Middleboro.
173	Darling's Animal Fertilizer,	American Agric. Chem. Co. (L. B. Darling Fert. Co.),	Middleboro.
425	Imperial Liquid Plant Food,	Eastern Chemical Co., Boston, Mass.,	Boston.
342	Great Eastern Garden Special,	American Agric. Chem. Co. (Great Eastern Fert. Co.),	Whately.
353	Great Eastern Grass and Oats,	American Agric. Chem. Co. (Great Eastern Fert. Co.),	Whately.
428	Pure Unleached Hardwood Ashes,	F. E. Hancock, Walkertown, Ontario, Canada,	Amherst.
423	Ferti Flora,	C. W. Hastings, Jamaica Plain, Mass.,	Boston.
427	Pure Canada Unleached Wood Ashes,	John Joynt, Lucknow, Ontario, Canada,	Amherst.
161	Potato Manure,	Lowell Fertilizer Co., Boston, Mass.,	Bridgewater.
284	Potato Manure,	Lowell Fertilizer Co., Boston, Mass.,	Lowell.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
126	Potato Manure,	11.37	3.33	2.5-3.25	4.03	3.26	2.84	10.13	8-11	7.29	6 8	5.55	5 6
208	Great Planet Manure,	10.78	4.29	3.30-4.12	4.77	3.57	1 82	10.16	9-13	8.34	8-11	7.10	7 8
228	Columbian Bone Superphosphate,	7.43	1.39	1.20-1.60	7.27	1.71	4.38	13.36	11-13	8.98	9-11	2.24*	1.85-2.00
68-138	American Farmers' Market Garden Special,	10.39	4.03	3.40-4.00	6.65	2.02	2.38	11.05	9.5-10.5	8.67	8-9	6.78*	7-8
150	American Farmers' Complete Potato Manure	12.70	1.61	1.60-2.00	5 22	2.17	1.97	9.36	8.5-9.00	7.39	7 9	6.15*	6-7
262	Farmers' Grass and Grain Fertilizer,	12.40	1.19	80 1.00	4.71	3.17	3.81	11.69	10 11	7.88	8.5-10	2.22*	1.5-2.00
235-410	Americus Corn Phosphate,	14 34	2.09	2.06 2.88	5.48	2.98	2 18	10.64	10-12	8.46	8-10	1.83	1.5-2.4
124	Darling's Farm Favorite,	8 97	2 62	2.05-2.88	4.41	4.30	2 50	11.21	9-12	8 71	8-10	3.25	3-4
173	Darling's Animal Fertilizer,	9.95	3.63	3.30-4.12	6 56	2.24	2.00	10.80	10-13	8.80	8-10	3.98	4-5
425	Imperial Liquid Plant Food,	90 38	1.06	1	1.54	—	—	1.54	1	1.54	1	1.72	1
342	Great Eastern Garden Special,	12.85	3.34	3.30 4.12	6.46	3.14	1.15	10.75	9-13	9.60	8-11	7.22	7-8
353	Great Eastern Grass and Oats,	12.53	—	—	7 36	2.67	2 07	12.10	12-15	10.03	11-13	2 40	2-3
428	Pure Unleached Hard Wood Ashes,	13.97	—	—	—	—	—	1.71	1 00-2.00	—	—	5.73	5-7
423	Ferti Flora,	82.86	4.47	3.25	3.93	—	—	3.93	3.66	3.93	3.66	3-47	3.3
427	Canada Unleached Wood Ashes,	4.32	—	—	—	—	—	1.65	1.5-3	—	—	5.28	5-8
161-284	Potato Manure,	6.21	1.76	1.64-2.46	5.86	.97	2.25	9.08	8-10	6 83	7-9	4.14*	4-5

*Sulphate of Potash the source of Potash.

II. ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1901 IN THE GENERAL MARKET BY THE AGENT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
244	Dissolved Bone and Potash,	Lowell Fertilizer Co., Boston, Mass ,	Hamilton.
302	Dissolved Bone and Potash,	Lowell Fertilizer Co., Boston, Mass.,	Lowell.
261	Lowell Tobacco Manure,	Lowell Fertilizer Co., Boston, Mass.,	Bernardston.
160	Fruit and Vine for Strawberries,	Lowell Fertilizer Co., Boston, Mass.,	W. Bridgewa'r
229	Fruit and Vine for Strawberries,	Lowell Fertilizer Co., Boston, Mass.,	Hamilton.
176	Market Garden Manure,	Lowell Fertilizer Co., Boston, Mass.,	W. Wareham.
298	Market Garden Manure,	Lowell Fertilizer Co.. Boston, Mass.,	Lowell.
188	Special Corn and Potato,	Lister's Agricultural Chemical Works, Newark, N. J.,	Fair Haven.
195	Special Corn and Potato,	Lister's Agricultural Chemical Works, Newark, N. J.,	Norwood.
123	Animal Bone "No. 2" and Potash,	Lister's Agricultural Chemical Works, Newark, N. J.,	Fair Haven.
41	Mitchell's Special Vegetable Fertilizer,	Mitchell Fertilizer Co., Tremley, N. J.,	Seekonk.
141	Mitchell's Special Vegetable Fertilizer,	Mitchell Fertilizer Co , Tremley, N. J.,	Dighton.
142	Mitchell's Special Vegetable Fertilizer,	Mitchell Fertilizer Co., Tremley, N. J.,	Dighton.
107	Cereal Brand,	Mapes' Formula and Peruvian Guano Co., N. Y. City,	Taunton.
258	Cereal Brand,	Mapes' Formula and Peruvian Guano Co., N. Y. City,	Greenfield.
127	Fruit and Vine Manure,	Mapes' Formula and Peruvian Guano Co., N. Y. City,	Taunton.
202	Economical Potato Manure,	Mapes' Formula and Peruvian Guano Co., N. Y. City,	Taunton.
211	Economical Potato Manure,	Mapes' Formula and Peruvian Guano Co., N. Y. City,	Fitchburg.
350	Tobacco Ash Constituents,	Mapes' Formula and Peruvian Guano Co., N. Y. City,	Northampton.
429	Pure Canada Unleached Wood Ashes,	Geo. L. Munroe Oswego. N. Y.,	Amherst.
207	Chittenden's Potato Phosphate,	National Fertilizer Co., Bridgeport, Conn.,	Fitchburg.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
244-302	Dissolved Bone and Potash,	8.87	1.91	1.65-2.50	6.12	2.17	2.12	10.41	10-12	8.29	9-11	2.00	2 3
261	Lowell Tobacco Manure,	5.99	5.16	5.94-5.75	5.18	1.04	1.33	7.55	7-10	6 22	6-9	7.46*	8-9
160-229	Fruit and Vine for Strawberries,	7.49	3.24	2.47-3.30	5.80	2.39	2 33	10.52	9-11	8.19	8-10	5.14*	6-7
176-298	Market Garden Manure,	7.82	4.77	4.10-4.92	4 58	1.92	2.15	8.65	8-11	6.50	7-9	6.24*	6 7
188-195	Special Corn and Potato,	12.98	1.91	1.65-2.40	6.08	2.62	2.61	11.31	9-12	8.70	8-11	3.56	3-4
123	Animal Bone "No. 2" and Potash,	12.89	—	—	5.86	4.77	2 44	13.07	10	10.63	9	2.58	5.
41-141-142	Mitchell's Special Vegetable Fertilizer,	9.56	3.58	3.5-4.00	6.43	4.47	1.77	12.67	10-11	10.90	8-10	5.84	6-7
107-258	Cereal Brand,	11.89	1.80	1.65-2.47	3.43	4.81	1.74	9.98	8-10	8.24	6-8	3.04	3-3.5
127	Fruit and Vine Manure,	7 83	2.13	1.65-2.47	1.85	3.39	2 87	8.11	7-9	5.24	5-7	10.52*	10-12
202-211	Economical Potato Manure,	10.17	3.37	3.29-4.12	1.47	3 62	2 28	7.37	6-8	5 09	4-5	8.82*	8-10
350	Tobacco Ash Constituents,	7.45	1.16	.5	—	3.76	2.94	6.70	5.7	3.76	—	17.70	15.
429	Pure Canada Unleached Wood Ashes,	13.32	—	—	—	—	—	1.51	1.5 3.	—	—	6.03	5 7
207	Chittenden's Potato Phosphate,	16.15	2.79	2.06-2.88	6.88	1.21	2.99	11.08	10-12	8.09	8-11	6.19	6-7

*Sulphate of Potash the source of Potash.

II. ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1901, IN THE GENERAL MARKETS BY THE AGENT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
162	Ammoniated Bone Superphosphate,	National Fertilizer Co., Bridgeport, Conn.,	Dighton.
271	Ammoniated Bone Superphosphate,	National Fertilizer Co., Bridgeport, Conn.,	Leominster.
199	Market Garden,	National Fertilizer Co., Bridgeport, Conn.,	New Bedford.
95	Fish and Potash,	National Fertilizer Co., Bridgeport, Conn.,	New Bedford.
395	Chittenden's Universal Phosphate.	National Fertilizer Co., Bridgeport, Conn.,	Gt. Barrington
170	Mixed Fertilizer,	New Bedford Product Co., New Bedford, Mass.,	NewBedford.
322	High Grade Truck Fertilizer,	New England Fertilizer Co., Boston, Mass.,	Amesbury.
227	Pacific Potato Special,	American Agric. Chem. Co. (Pacific Guano Co.),	Georgetown.
276	Pacific Potato Special,	American Agric. Chem. Co. (Pacific Guano Co.),	Newburyport.
369	Packers' Union Potato Manure,	American Agric. Chem. Co. (Packers' Union Fert. Co.),	S.Willia'stown
371	Wheat, Oats and Clover,	American Agric. Chem. Co. (Packers' Union Fert Co.),	S.Willia'stown
426	Complete Tobacco Fertilizer,	Olds & Whipple, Hartford, Conn.,	Hatfield.
158	Special with 10 per cent Potash,	American Agric. Chem.Co. (Quinnipiac Co.),	Bridgewater.
52	Complete Grass Fertilizer,	American Agric. Chem. Co. (Quinnipiac Co.).	Seekonk.
155	Complete Grass Fertilizer,	American Agric. Chem. Co. (Quinnipiac Co.),	Bridgewater.
143	Soluble for Corn and General Crops,	Rogers & Hubbard Co., Middletown, Conn.,	Bridgewater.
236	Hubbard's for All Soils and All Crops,	Rogers & Hubbard Co., Middletown, Conn.,	Framingham.
279	Hubbard's for All Soils and All Crops,	Rogers & Hubbard Co., Middletown, Conn.,	Harvard.
272	Hubbard's Potato Phosphate,	Rogers & Hubbard Co., Middletown, Conn.,	Framingham.
382	Hubbard's Potato Phosphate,	Rogers & Hubbard Co., Middletown, Conn.,	Mouson.
225	Hubbard's Corn Phosphate,	Rogers & Hubbard Co., Middletown, Conn.,	Framingham.
390	Hubbard's Corn Phosphate,	Rogers & Hubbard Co., Middletown, Conn.,	Mouson.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
162-271	Ammoniated Bone Superphosphate,	11.92	1.87	1.65-2.47	6.63	3.45	1.51	11.59	10-12	10.08	8-11	2.78	2-3
199	Market Garden,	13.67	2.20	2.47-3.39	7.01	2.87	1.61	11.49	9-10	9.88	8-10	6.62	6-8
95	Fish and Potash,	9.33	3.13	2 5-3.00	4.20	1.35	3.12	8.67	8-9	5.55	5-6	3.98	3-4
395	Chittenden's Universal Phosphate,	8 02	1.16	.80-1.00	7-27	2.74	1.38	11.39	10-12	10.01	8-10	1.52	1-2
170	Mixed Fertilizer,	9.57	2.23	—	—	2.25	.56	2.81	—	2.25	—	.76	--
322	High Grade Truck Fertilizer,	5.93	3.45	3.30-4.12	4.13	2.44	1.87	8.44	6-8	6.57	5-7	11.42*	10-11
227-276	Pacific Potato Special,	12 47	2 31	2.06-2.88	5.95	2.34	3.86	12.15	10-13	8.29	8-10	3.28	3-4
369	Parker's Union Potato Manure,	11.34	2.18	2.06-2.88	6.46	2.52	2.12	11.10	10-13	8.98	8-10	5.58	6-7
371	Wheat, Oats and Clover,	16.43	—	—	6.56	4 72	1.33	12.61	12-15	11.28	11-13	2.16	2-3
426	Complete Tobacco Fertilizer,	8 10	4.66	4.53-5.36	1.77	2.17	.41	4.35	—	3.94	3-4	5.02	5.5-6.5
158	Special with 10 per cent Potash,	9.67	2.28	2.4-3 4	3.90	2.32	1.89	8.11	7-10	6.22	6-8	10.20	10-12
52-155	Complete Grass Fertilizer,	9.38	3.88	3.90	2.44	2.70	2.15	7.29	6-9	5.14	5-7	2.28*	2-3
143	Soluble for Corn and General Crops,	9.74	2.38	2.5-3.00	.90	6.46	2.54	9.90	8-10	7.36	6-7	8.66	8-9
236-279	Hubbard's for All Soils and All Crops,	13.16	2.18	2.30-3.00	8.44	2.15	2.23	12.82	12-14	10.59	10-12	3.32	3-4
272-382	Hubbard's Potato Phosphate,	13.50	1.92	2-2.5	7.14	2.20	2.56	11.90	10-12	9.34	9-10	4.86	5-6
225-390	Hubbard's Corn Phosphate,	13.16	1.00	1-1.50	6.56	2.68	1.92	11.16	10-12	9.24	8-10	3.74	3.5-4.

*Sulphate of Potash the source of Potash.

II. ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1901, IN THE GENERAL MARKETS BY THE AGENT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
21	High Grade Complete Corn and Onion Manure,	Rogers Manufacturing Co., Rockfall, Conn.,	No. Amherst.
351	High Grade Complete Corn and Onion Manure,	Rogers Manufacturing Co., Rockfall, Conn.,	Pittsfield.
381	High Grade Complete Corn and Onion Manure,	Rogers Manufacturing Co., Rockfall, Conn.,	Gt. Barrington
358	High Grade for Oats and Top Dressing	Rogers Manufacturing Co., Rockfall, Conn.,	Pittsfield.
388	High Grade for Oats and Top Dressing,	Rogers Manufacturing Co., Rockfall, Conn.,	Gt. Barrington
20	High Grade Grass and Grain Fertilizer,	Rogers Manufacturing Co , Rockfall, Conn.,	No. Amherst.
22	Fish and Potash,	Rogers Manufacturing Co., Rockfall, Conn.,	No. Amherst.
379	All Around Fertilizer,	Rogers Manufacturing Co., Rockfall, Conn.,	Gt. Barrington
63	Complete Manure for Corn, Grain and Grass,	Russia Cement Co., Gloucester, Mass.,	Taunton.
151	Complete Manure for Corn, Grain and Grass,	Russia Cement Co., Gloucester, Mass.,	Needham.
335	Complete Manure for Corn, Grain and Grass,	Russia Cement Co., Gloucester, Mass.,	Pittsfield.
397	Complete Manure for Corn, Grain and Grass,	Russia Cement Co., Gloucester, Mass.,	Worcester.
73	Complete Manure for Potatoes, Roots and Vegetables,	Russia Cement Co., Gloucester, Mass.,	Taunton.
91	Complete Manure for Potatoes, Roots and Vegetables,	Russia Cement Co., Gloucester, Mass.,	Needham.
402	Complete Manure for Potatoes, Roots and Vegetables,	Russia Cement Co., Gloucester, Mass.,	Spencer.
411	Complete Manure for Potatoes, Roots and Vegetables,	Russia Cement Co., Gloucester, Mass.,	Worcester.
204	Essex Corn Fertilizer,	Russia Cement Co., Gloucester, Mass.,	Bernardston.
336	Essex Corn Fertilizer,	Russia Cement Co., Gloucester, Mass.,	Williamstown.
354	Essex Dry Ground Fish,	Russia Cement Co., Gloucester, Mass.,	Pittsfield.
366	Essex Dry Ground Fish,	Russia Cement Co., Gloucester, Mass.,	Hatfield.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
21-351-381	High Grade Comp. Corn and Onion Manure,	9.89	3.22	3.6-4.	5.82	1.47	2.33	9.62	8-9	7.29	6-7	7.62	7-8
358-388	High Grade for Oats and Top Dressing,...	8.40	5.68	6.3-6.8	1.51	5.78	2.71	10.00	9-10.5	7.29	7-9	8.48	7.5-8.5
20	High Grade Grass and Grain Fertilizer,....	5.68	2.90	3-4	—	8 03	9.88	17.91	16-17	8.03	—	13.62	12 5-14.00
22	Fish and Potash,.....	7.86	2 94	3.25-3 50	3.04	2.21	2.84	8 09	6-8	5.25	4-5	3.90	3.75-4.50
379	All Around Fertilizer,.....	14.88	1.38	1.65-2.65	7.42	2.00	2.61	12.03	10-12	9.42	8-10	3.32	2-3
63-151-335-397	Complete Manure for Corn, Grain and Grass	11.82	3.35	3.30-4 10	4.39	3.18	2.64	10.21	9.5-11	7.57	7-8	9.94	9.5-11
73 91-402 411	Comp. Manure for Potatoes, Roots and Veg.	8.43	3.74	3 7-4.20	3.77	4.09	2.66	10.52	9-11	7.86	7-8	8.92*	8-10
204-336	Essex Corn Fertilizer,.....	8.29	2 00	2.00-2 50	2.28	5.37	5 71	13.36	11-13	7.65	9-10	3.52	3-3.5
354-366	Essex Dry Ground Fish,.....	7.68	7.82	8-10	—	4.96	8.98	13.94	11-13	4.96	—	—	—

*Sulphate of Potash the source of Potash.

II. ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1901, IN THE GENERAL MARKETS BY THE AGENT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Compound Fertilizers.		
56	Market Garden and Potato Manure,	Russia Cement Co., Gloucester, Mass.,	Taunton.
109	Market Garden and Potato Manure,	Russia Cement Co., Gloucester, Mass.,	Needham.
408	Market Garden and Potato Manure,	Russia Cement Co., Gloucester, Mass.,	Worcester.
66	Odorless Lawn Dressing,	Russia Cement Co., Gloucester, Mass.,	Taunton.
105	Odorless Lawn Dressing,	Russia Cement Co., Gloucester, Mass.,	Hudson.
108	Essex A I Superphosphate,	Russia Cement Co., Gloucester, Mass.,	Needham.
396	Essex A I Superphosphate,	Russia Cement Co., Gloucester, Mass.,	Spencer.
205	Read's Practical Potato Special,	American Agric. Chem. Co. (Read Fertilizer Co.)	Greenfield.
269	Fish, Bone and Potash,	American Agric. Chem. Co. (Read Fertilizer Co.)	Greenfield.
373	Sanderson's Formula "A,"	Sanderson's Fert. and Chem. Co., New Haven, Conn.,	Lanesboro.
357	Sanderson's Old Reliable Superphosphate,	Sanderson's Fert. and Chem. Co., New Haven, Conn.,	Lanesboro.
385	Sanderson's Old Reliable Superphosphate,	Sanderson's Fert. and Chem. Co., New Haven, Conn.,	Monson.
49	Sanderson's Special Strawberry Fertilizer,	Sanderson's Fert. and Chem. Co., New Haven, Conn.,	Seekonk.
57	Potato Manure,	Wilcox Fertilizer Works, Mystic, Conn.,	Fall River.
65	Potato Manure,	Wilcox Fertilizer Works, Mystic, Conn.,	Seekonk.
219	Royal Bone Phosphate,	American Agric. Chem. Co. (Williams & Clark Fert.Co.)	Marlboro.
300	Prolific Crop Producer,	American Agric. Chem. Co. (Williams & Clark Fert.Co.)	Lowell.
230	Wheeler's Bermuda Onion Grower,	American Agric. Chem. Co. (M. E. Wheeler & Co.),	Georgetown.
288	Wheeler's Bermuda Onion Grower,	American Agric. Chem. Co. (M. E. Wheeler & Co.),	Greenfield.
189	Wheeler's Grass and Oats Fertilizer,	American Agric. Chem. Co. (M. E. Wheeler & Co.),	Hudson.
203	Wheeler's Superior Truck Fertilizer,	American Agric. Chem. Co. (M. E. Wheeler & Co.),	Greenfield.
418	Champion Animal Fertilizer,	Darius Whithed, Saugus, Mass.,	Lowell.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
56-109-408	Market Garden and Potato Manure,	12.84	2.14	2. 2.5	3.20	4,27	4.53	12 00	10 13	7.47	8-10	5.06	5-6
66-105	Odorless Lawn Dressing,	2.96	3.71	3.7-4 5	1.28	4.40	5.73	11.41	8-10	5.68	6-7	8.07*	7-8
108-396	Essex A. I. Superphosphate,	8.91	1.22	1 1.25	.68	2.75	5.73	9.16	9-11	3.43	7-8	2.28	2-2.5
205	Read's Practical Potato Special,	7 54	1 22	.82-1.65	1.66	2.34	3.91	7.91	5-8	4.00	4-6	9.28	8-10
269	Fish, Bone and Potash,	15.19	2.44	2 3	1.22	3.45	2.57	7.24	5-8	4.67	4 6	4.07	4-6
373	Sanderson's Formula "A"	10 09	3.47	3.30-4 12	.96	4.11	5.45	10.52	10-12	5.07	6-8	7.07	6-8
357-385	Sanderson's Old Reliable Superphosphate,	12.21	3.27	2.47-3 30	1.98	3.06	5.68	10.72	10 12	5.04	7-8	3.17	2-3
49	Sanderson's Special Strawberry Fertilizer,	6.79	2.08	2-3	.87	3.76	9.01	13.64	12-14	4.63	—	7.76	5-7
57-65	Potato Manure,	11.75	2.12	2-3	1.47	3.32	5.32	10.11	7-9	4.79	6-8	5.80	4.5-5.5
219	Royal Bone Phosphate,	15.42	1.62	1.03-2.47	5.18	2.49	2 87	10.54	10-15	7.67	8-11	2.07	2-3
300	Prolific Crop Producer,	13.60	1.26	.82-1.65	2.88	4.16	3.19	10.23	8.11	7.04	6-8	1.24	1-2
230-288	Wheeler's Bermuda Onion Grower,	13.49	.97	.83-1.65	5.25	3.27	2.58	11.10	10-13	8.52	8-10	4.00	4-5
189	Wheeler's Grass and Oats Fertilizer,	12.07	—	—	7.80	2.95	1.61	12.36	12-15	10.75	11-13	2.28	2-3
203	Wheeler's Superior Truck Fertilizer,	10.92	3.32	3.30-4.12	5.48	2.58	2.48	10.54	9-13	8.06	8-11	7.13	7-8
418	Champion Animal Fertilizer,	3.12	3.82	3.92	—	6.29	8.52	14.81	13.56	6.29	—	8.02	7.46

*Sulphate of Potash the source of Potash.

II. ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1901, IN THE GENERAL MARKETS BY THE AGENT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Chemicals.		
121	Muriate of Potash,	American Agricultural Chemical Co., Boston, Mass.,	New Bedford.
179	Muriate of Potash,	American Agricultural Chemical Co., Boston, Mass.,	Boston.
180	Double Manure Salts,	American Agricultural Chemical Co., Boston, Mass.,	Boston.
33	High Grade Sulphate of Potash,	American Agricultural Chemical Co., Boston, Mass.,	Springfield.
268	High Grade Sulphate of Potash,	American Agricultural Chemical Co., Boston, Mass.,	Greenfield.
34	Nitrate of Soda,	American Agricultural Chemical Co., Boston, Mass.,	Springfield.
112	Nitrate of Soda,	American Agricultural Chemical Co., Boston, Mass.,	New Bedford.
247	Nitrate of Soda,	American Agricultural Chemical Co., Boston, Mass.,	Leominster.
177	Dried Blood,	American Agricultural Chemical Co., Boston, Mass.,	Boston.
181	Dissolved Bone Black,	American Agricultural Chemical Co., Boston, Mass.,	Boston.
53	Nitrate of Soda,	Bowker Fertilizer Co., Boston, Mass.,	Taunton.
64	Nitrate of Soda,	Bowker Fertilizer Co., Boston, Mass.,	Fall River.
75	Nitrate of Soda,	Bowker Fertilizer Co., Boston, Mass.,	Fall River.
77	Dissolved Bone Black,	Bowker Fertilizer Co., Boston, Mass.,	Fall River.
217	Dissolved Bone Black,	Bowker Fertilizer Co., Boston, Mass.,	Concord.
32	Muriate of Potash,	Bowker Fertilizer Co., Boston, Mass.,	Springfield.
78	Muriate of Potash,	Bowker Fertilizer Co., Boston, Mass.,	Fall River.
362	Muriate of Potash,	Bowker Fertilizer Co., Boston, Mass.,	Northampton.
348	High Grade Sulphate of Potash,	Bowker Fertilizer Co., Boston, Mass.,	Northampton.
293	Dried Blood,	Bowker Fertilizer Co., Boston, Mass.,	Concord.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Chemicals.												
121-179	Muriate of Potash,	2.17	—	—	—	—	—	—	—	—	—	49.40	50-55
180	Double Manure Salts,	.68	—	—	—	—	—	—	—	—	—	25.84	25-28
33-268	High Grade Sulphate of Potash,	.46	—	—	—	—	—	—	—	—	—	49.32	48-50
34-112-247	Nitrate of Soda,	1.93	15.90	15.8	—	—	—	—	—	—	—	—	—
177	Dried Blood,	9.20	11.20	10-11.57	—	—	—	—	—	—	—	—	—
181	Dissolved Bone Black,	13.20	—	—	12.64	2.66	1.56	16.86	16-18	15.30	15-18	—	—
53-64-75	Nitrate of Soda,	2.29	15.61	15-16	—	—	—	—	—	—	—	—	—
77-217	Dissolved Bone Black,	9.47	—	—	9.70	5.73	2.33	17.76	16-20	15.43	15-18	—	—
32-78-362	Muriate of Potash,	2.47	—	—	—	—	—	—	—	—	—	48.48	50-52
348	High Grade Sulphate of Potash,	.39	—	—	—	—	—	—	—	—	—	48.84	48-52
293	Dried Blood,	7.03	8.41	8.24-9.89	—	—	—	—	—	—	—	—	—

II. ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1901, IN THE GENERAL MARKETS BY THE AGENT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Chemicals.		
266	Bowker's Superphosphate,	Bowker Fertilizer Co., Boston, Mass.,	Fitchburg.
273	Sulphate of Potash-Magnesia,	Bowker Fertilizer Co., Boston, Mass ,	Fitchburg.
135	Nitrate of Soda,	E. Frank Coe Co., New York City,	Dighton.
415	Acid Phosphate,	Lowell Fertilizer Co., Boston, Mass.,	Worcester.
304	Muriate of Potash,	Lowell Fertilizer Co., Boston, Mass.,	Amesbury.
309	Nitrate of Soda,	Lowell Fertilizer Co., Boston, Mass.,	Amesbury.
401	Nitrate of Soda,	Lowell Fertilizer Co., Boston, Mass.,	Worcester.
310	High Grade Sulphate of Potash,	Lowell Fertilizer Co., Boston, Mass.,	Amesbury.
405	High Grade Sulphate of Potash,	Lowell Fertilizer Co., Boston, Mass.,	Worcester.
340	Mapes' Dissolved Bone Black,	Mapes' Formula and Peruvian Guano Co., N. Y. City	So. Deerfield.
363	High Grade Sulphate of Potash,	Mapes' Formula and Peruvian Guano Co., N. Y. City	So. Deerfield.
364	Nitrate of Soda,	Mapes' Formula and Peruvian Guano Co., N. Y. City	So. Deerfield.
62	Nitrate of Soda,	Wilcox Fertilizer Works, Mystic, Conn.,	Fall River.
84	Muriate of Potash,	Wilcox Fertilizer Works, Mystic, Conn.,	Fall River.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Potassium Oxide in 100 lbs.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Chemicals.												
266	Bowker's Superphosphate,	5.84	—	—	3.75	7.87	2.50	14.12	15-17	11.62	12-15	—	—
273	Sulphate of Potash-Magnesia,	7.48	—	—	—	—	—	—	—	—	—	23 56	26-28
135	Nitrate of Soda,	1.31	15.16	—	—	—	—	—	—	—	—	—	—
415	Acid Phosphate,	8.97	—	—	10.85	1.56	1.15	13.56	12 15	12.41	—	—	—
304	Muriate of Potash,	1.51	—	—	—	—	—	—	—	—	—	50 30	50-53
309-401	Nitrate of Soda,	.90	15.75	15.64	—	—	—	—	—	—	—	—	—
310-405	High Grade Sulphate of Potash,	.97	—	—	—	—	—	—	—	—	—	46.10	48-50
340	Mapes' Dissolved Bone Black,	13.36	—	—	16.63	.49	.61	17.73	17-19	17.12	15-16	—	—
363	High Grade Sulphate of Potash,	.34	—	—	—	—	—	—	—	—	—	50.30	48.67-51.38
364	Nitrate of Soda,	1.15	15.39	15.81-16.14	—	—	—	—	—	—	—	—	—
62	Nitrate of Soda,	1.19	15.70	15.6-17.	—	—	—	—	—	—	—	—	—
84	Muriate of Potash,	1.00	—	—	—	—	—	—	—	—	—	49.36	50.5-53.7

II. ANALYSES OF COMMERCIAL FERTILIZERS COLLECTED DURING 1901, IN THE GENERAL MARKETS BY THE AGENT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at
	Ground Bones and Tankage.		
40	Fine Ground Bone,	American Agric. Chem. Co. (Bradley Fertilizer Co.),	Weir.
163	Fine Ground Bone,	American Agric. Chem. Co. (Bradley Fertilizer Co.),	New Bedford.
267	Fine Ground Bone,	American Agric. Chem. Co. (Bradley Fertilizer Co.),	Greenfield.
307	Fine Ground Bone,	American Agric. Chem. Co. (Bradley Fertilizer Co.),	Newburyport.
281	Bone Meal,	Armour Fertilizer Works, Baltimore, Md.,	Danvers.
345	Bowker's Tankage,	Bowker Fertilizer Co., Boston, Mass.,	Northampton.
54	Fresh Ground Bone,	Bowker Fertilizer Co., Boston, Mass.,	Taunton.
100	Pure Ground Bone,	Bartlett & Holmes, Springfield, Mass.,	Boston.
392	Pure Ground Bone,	Bartlett & Holmes, Springfield, Mass.,	Springfield.
387	High Grade Ground Tankage,	Bartlett & Holmes, Springfield, Mass.,	Springfield.
200	Dow's Pure Ground Bone,	John C. Dow & Co., Boston, Mass.,	Boston.
419	Dow's Pure Ground Bone,	John C. Dow & Co., Boston, Mass.,	Boston.
92	Raw Ground Bone,	Lowell Fertilizer Co., Boston, Mass.,	Boston.
94	Raw Ground Bone,	Lowell Fertilizer Co., Boston, Mass.,	Boston.
315	Ground Tankage,	Lowell Fertilizer Co., Boston, Mass.,	Amesbury.
231	Tankage,	Lowe Bros. & Co., Fitchburg, Mass.,	Fitchburg.
242	Pure Ground Bone,	Parmenter & Polsey Fertilizer Co., Peabody, Mass.,	Beverly.
376	Pure Ground Bone,	Rogers Manufacturing Co., Rockfall, Conn.,	Lee.
99	Ground Bone,	T. L. Stetson, Randolph, Mass.,	Boston.
196	Ground Bone,	T. L. Stetson, Randolph, Mass.,	Brockton.
420	Ground Bone,	T. L. Stetson, Randolph, Mass.,	Randolph.
103	Flour of Bone,	Darius Whithed, Saugus, Mass.,	Boston.
417	Flour of Bone,	Darius Whithed, Saugus, Mass.,	Lowell.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in 100 lbs.		Phosphoric Acid in 100 lbs.							Mechanical Analyses.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Total.		Available.		Fine Bone.	Fine Medium.	Medium.	Coarse Medium.
								Found.	Guaranteed.	Found.	Guaranteed.				
	Ground Bones and Tankage.														
40-163-267-307	Fine Ground Bone,	10.63	3.01	2.47-3.29	—	8.93	13.51	22.44	22.50	8.93	—	26.66	42.23	25.57	5.54
281	Bone Meal,	4.65	3.32	2.47-3.29	—	12.58	12.08	24.66	24-26	12.58	10-14	62.12	21.55	13.53	2.80
345	Bowker's Tankage,	7.42	5.41	5.77-6.59	—	3.97	7.01	10.98	11-13	3.97	—	33.30	28.21	22.96	15.53
54	Fresh Ground Bone,	7.23	2.27	2.25-3.25	—	6.27	17.73	24.00	24-26	6.27	5-7	21.80	44.96	22.56	10.68
100-392	Pure Ground Bone,	3.95	2.60	2-3	—	9.70	16.04	25.74	27-29	9.70	—	56.71	41.35	1.94	—
387	High Grade Ground Tankage,	10.16	4.16	4.12-4.94	—	6.70	11.95	18.65	17-18	6.70	—	12.89	49.18	37.93	—
200-419	Dow's Pure Ground Bone,	8.99	2.01	1.65-2.47	—	6.32	19.11	25.43	24-26	6.32	—	42.98	46.71	10.31	—
92-94	Raw Ground Bone,	3.89	2.91	2.47-3.29	—	7.55	18.91	26.46	25-28	7.55	—	52.70	30.09	11.68	5.53
315	Ground Tankage,	5.49	5.43	4.94-6.59	—	7.93	10.62	18.55	13.74-18.32	7.93	—	44.45	28.69	20.02	6.84
231	Tankage,	4.52	2.41	2-3	—	13.27	13.33	26.60	26-27	12.27	—	16.44	14.44	9.59	59.53
242	Pure Ground Bone,	4.96	1.81	2-3	—	11.06	12.15	23.21	16-20	11.06	6-8	63.68	25.91	9.62	.79
376	Pure Ground Bone,	10.08	4.47	3.8-4.8	—	11.23	14.51	25.74	25-26	11.23	—	74.13	24.62	1.25	—
99-196-420	Ground Bone,	10.17	4.34	4.20	—	8.73	13.53	22.26	20.66	8.73	—	17.03	35.68	31.20	16.09
103-417	Flour of Bone,	8.33	1.90	1.77	—	14.22	14.56	28.78	27.92	14.22	—	26.17	54.75	19.08	—

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	1901 Cents per pound
Nitrogen in ammonia salts,	16.5
" nitrates,	14.0
Organic nitrogen in dry and fine ground fish, meat, blood, and in high-grade mixed fertilizers,	16.0
" " " fine bone and tankage,	16.0
" " " medium bone and tankage,	12.0
Phosphoric acid soluble in water,	5.0
" " soluble in ammonium citrate,	4.5
" " in fine ground fish, bone and tankage,	4.0
" " in cottonseed meal, castor pomace and wood ashes,	4.0
" " in coarse fish, bone and tankage,	3.0
" " insoluble (in water and in am. cit.) in mixed fertilizers,	2.0
Potash as Sulphate, free from Chlorides,	5.0
" " Muriate,	4.25

The market value of low priced materials used for manurial purposes, as salt, wood ashes, various kinds of lime, barnyard manure, factory refuse and waste materials of different description, quite frequently does not stand in close relation to the current market value of the amount of essential articles of plant food they contain. Their cost varies in different localities. Local facilities for cheap transportation and more or less advantageous mechanical conditions for a speedy action, exert as a rule, a decided influence on their selling price.

Valuation. The approximate value of a compound fertilizer or any material used for fertilizing purposes is obtained by calculating the value of each of the three essential elements of plant food (nitrogen, phosphoric acid and potassium oxide, including the different forms of each wherever different forms are recognized in the table), in one hundred pounds of the fertilizer and multiply each product by twenty to change it to a ton basis. The sum of these values will give the total approximate value of the fertilizer per ton at the principal places of distribution.

HATCH EXPERIMENT STATION

—OF THE—

MASSACHUSETTS

AGRICULTURAL COLLEGE.

BULLETIN NO. 78.

CONCENTRATED FEED-STUFFS.

JANUARY, 1902.

The Bulletins of this Station will be sent free to all newspapers in the State and to such individuals interested in farming as may request the same.

AMHERST, MASS.:
PRESS OF CARPENTER & MOREHOUSE.
1902.

HATCH EXPERIMENT STATION

OF THE

Massachusetts Agricultural College,

AMHERST, MASS.

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The co-operation and assistance of farmers, fruit-growers, horticulturists, and all interested, directly or indirectly, in agriculture, are earnestly requested. The Bulletins will be sent free to all newspapers in the State and to such individuals interested in farming as may request the same. General bulletins, fertilizer analyses, analyses of feed-stuffs, and annual reports are published. Kindly indicate in application which of these are desired. Communications may be addressed to the

HATCH EXPERIMENT STATION, Amherst, Mass.

Division of Foods and Feeding.

JOSEPH B. LINDSEY.*

RESULTS AND SUGGESTIONS.

1. Nearly all of the cottonseed meal had a guaranty of composition, and the protein content was above the average. *Consumers are advised to purchase only guaranteed meals.*

2. A few of the linseed products were guaranteed; most of the new process meals were of average quality, while many of the old process were inferior. Purchasers are cautioned against unguaranteed linseed products.

3. A large portion of the gluten products were guaranteed, but failed to maintain their protein guaranty in many cases. Several lots were noticeably below the average in protein. It is advisable to observe the guaranty before purchasing.

4. Nearly all the wheat bran and middlings were free from foreign admixtures and of good quality. A number of samples of mixed feed contained ground corn cobs and wheat screenings. Of these, some were marked *Kentucky Milling Co.*, others *Kentucky*, and a few were unmarked. Consumers are urged to give the preference to those wheat by-products bearing the name of reputable manufacturers.

5. Corn and hominy meals were of good quality.

6. The larger portion of the oat offal upon the market was as usual decidedly inferior in feeding value. Many brands cost nearly as much as *corn meal*, and were only *one-half to two-thirds as valuable.*

7. Most of the mixtures sold as corn and oat feed consisted of oat offal, together with cracked corn or hominy meal. They are quite distinct and not as valuable as true provender, which is a mixture of whole or crushed oats and cracked corn.

8. For further information see the Analytical Tables and the article entitled, "Discussion of the Results."

*With the coöperation of E. B. Holland, P. H. Smith, Jr., and J. W. Kellogg.

CONCENTRATED FEED-STUFFS.

A. Definition of Terms.
B. Why Concentrated Feeds are Fed.
C. Classification.
D. Manufacture.
E. Protein Standards.
F. Results of Inspection.
G. Discussion of Results.
H. Miscellaneous Feed-stuffs.
I. Economic Feeds and Rations.
J. Topics of Interest.

A. DEFINITION OF TERMS.

The term "concentrated feed," or "concentrate," taken in its broadest sense, is meant to include the grains and other seeds of agricultural plants, as well as their manifold by-products left behind in the process of oil extraction and in the preparation of human foods.

All cattle feeds, whether concentrated or coarse, are made up of the following six groups of substances:

Water.—The several grains and by-products contain when placed upon the market from 6 to 12 per cent of water.

Ash represents the mineral ingredients of the feed. It will remain behind as ashes should the feed be burned. These ashes consist of lime, potash, soda, magnesia, iron, phosphoric acid and sulfuric acid.

Protein is the general name for all of the nitrogenous matter. It corresponds to the lean meat in the animal, and may be termed "vegetable meat." It has the same elementary composition as animal flesh, and is considered the most valuable part of the feed.

Fiber or Cellulose is the coarse or woody part of the plant. It may be called the plant's framework. It is present as a rule only to a limited extent in the grains and by-products.

Non-nitrogenous Extract Matter consists of sugars, starch and gums. The grains are very rich in starch and similar substances.

Fat includes not only the various fats and oils found in different feed stuffs, but also waxes, resins, and coloring matters. It is sometimes termed ether-extract, because it represents that portion of the plant soluble in ether. Fat found in grains and seeds is comparatively free from foreign substances (waxes, resins, etc.).

Carbohydrates.—The fiber and extract matter have the same functions in the process of nutrition, and collectively they are termed carbohydrates.

Nutritve Ratio.—The numerical relation which the protein of a feed bears to the carbohydrates (and fat reduced to carbohydrates) is termed its nutritive ratio. Fat is multiplied by 2.25 to convert it to carbohydrates. If a ton of feed should contain 96 pounds of digestible protein, and 928 pounds of digestible carbohydrates, it would have 9.4 times as much carbohydrates as protein or 1 : 9.4, which is its nutritive ratio.

Digestibility.—Any feed stuff is valuable as a source of nourishment only so far as its various parts can be digested and assimilated That the concentrated feeds are much more digestible than the coarse fodders may be shown by the following table :—

	100 lbs. Timothy Hay.			100 lbs. Cottonseed Meal.		
	Composition.	Per Cent Digestible.	Pounds Digestible.	Composition.	Per Cent Digestible.	Pounds Digestible.
Water,	15.0	—	—	7.0	—	—
Ash,	4.3	—	—	6.5	—	—
Protein,	6.3	48	3.02	45.1	88	39.7
Fiber,	28.4	58	16.47	6.1	32	2.0
Extract Matter,	43.60	63	27.46	24.2	64	15.5
Fat.	2.4	61	1.46	11.1	93	10.3
Total,	100.00	—	48.41	100.0	—	67.5

The timothy hay has only 48.4 pounds of digestible matter, while the cottonseed has 67.5 pounds.

B. WHY CONCENTRATED FEEDS ARE FED.

Most of the home-grown coarse feeds are high in carbohydrates, low in protein, and comparatively indigestible. Nearly all of the concentrated feeds are very digestible and a large number are high in protein and low to medium in carbohydrates. The concentrated feeds are fed with the home-grown coarse feeds therefore, *first to increase the digestible matter, and second to increase the amount of protein in the daily ration.*

An illustration. Many experiments have demonstrated that an average-sized new milch cow producing 12 to 15 quarts of milk daily needs approximately the following quantities of digestible nutrients:

Digestible:	Protein.	Fat.	Carbohydrates.	Total.
Pounds,	2.0 to 2.5	0.5	13.0	16.0

Now if the animal should be fed as much as she could consume of a good quality of hay, (30 pounds) she would have at her disposal:

Digestible:	Protein.	Fat.	Carbohydrates.	Total.
Pounds,	1.4	.30	12.6	14.3

This ration is deficient both in total nutrients and protein, for the reason that the hay lacks protein and has comparatively a low digestibility. If 7 pounds of the hay were replaced by an equal quantity of corn meal, the 23 pounds of hay and corn meal would furnish:

Digestible:	Protein.	Fat.	Carbohydrates.	Total.
Pounds,	1.5	.46	14.3	16.3

The corn meal being a very digestible, but a one-sided or starchy feed,has sufficiently increased the total digestible daily nutrients, but not the protein.

If 4 pounds of corn meal were replaced by 2 pounds of wheat bran and 2 pounds of cottonseed meal, the hay and several grains would supply:

Digestible:	Protein.	Fat.	Carbohydrates.	Total.
Pounds,	2.30	.70	12.8	15.8

The addition of 3 pounds of corn meal rich in digestible starchy matter, and 4 pounds of bran and cottonseed meal rich in digestible protein, to the 23 pounds of hay, have furnished the required quantities of total digestible matter and digestible protein.

C. CLASSIFICATION OF CONCENTRATED FEEDS.

Division I. Protein Feeds.			Division II. Starchy (Carbohydrate) Feeds.
Class I.	Class II.	Class III.	Class IV.
30 *to* 45% *protein.*	20 *to* 30% *protein.*	15 *to* 20% *protein.*	8 *to* 14% *protein.*
50 to 60% carbohydra's.*	60 to 70% carbohydra's.*	70 to 75% carbohydra's.*	75 to 85% carbohyd's.*
75 to 90% digestible.	80 to 85% digestible.	60 to 75% digestible	75 to 90% digestible.
Cottonseed meal.	Buffalo, Davenport, Marshalltown, National, Waukegan and other standard gluten feeds.	Wheat middlings, mixed feed and wheat bran.	Wheat, rye, barley, oat, corn and hominy meals.
N. P. and O. P. linseed meals.	Dried distillers'and brewers' grains and malt sprouts.	H–O dairy feed.	Oat, corn and oat, and corn oat and barley feeds.
Chicago, Cream, and King gluten meals.			Quaker dairy and H–O horse feeds.

* Including fat reduced to carbohydrates by the factor 2.25.

D. MANUFACTURE OF CONCENTRATED FEEDS.

Class I.

COTTONSEED MEAL.

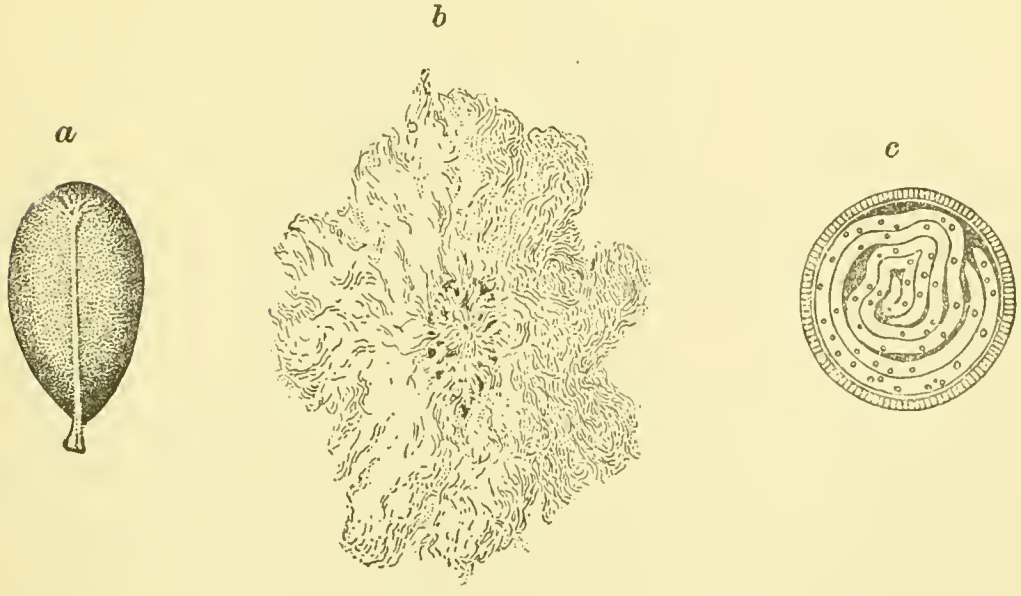


Figure I. a. Seed entirely free from fiber, (delinted) magnified three times. b. Seed covered with cotton, (coma). c. Section of seed showing crumpled embryo, (meat) filling the seed coats.

The seed of the cotton plant as it comes from the gin where the cotton fiber has been removed, is still covered with a coat of white down technically known as "linters." This being removed, the seed itself appears black in color and irregular egg-shape in form. The thick, hard, black seed coat or hull, is filled with the coiled embryo, (meat) which contains a large number of oil cells. Machines have been invented to remove the hull. The meat is cooked in large iron kettles, and while still hot is wrapped in hair cloth, and subjected to a pressure of 3000 to 4000 pounds to the square inch, to remove as much of the oil as possible. The pressed cottonseed cake when cracked and ground results in the bright yellow decorticated cotton-seed meal of commerce. A ton of seed furnishes about 800 pounds of meal. Sometimes a considerable amount of hull is ground fine and mixed with the meal, producing a dark colored article, having a feeding value of about one-half the prime material.

LINSEED MEALS.

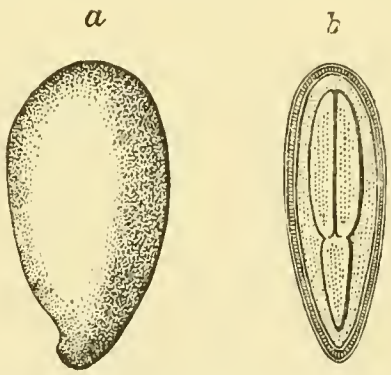


Figure II. Common flax (Linum usitatissimum). a. Seed magnified six times. b. Longitudinal section, showing embryo embedded in the endosperm.

The drawings for Figs. I. and II. from Hicks, in Year Book 1895, Department of Agriculture.

Linseed meal is the ground residue from the flaxseed, after the oil has been removed. The larger part of the flaxseed used in this country is grown in North and South Dakota and Minnesota. The seeds of the flax plant are flattened, elliptical oval, pointed at the lower end, and of a brown color. They contain in their natural state from 30 to 35 per cent of oil. Twenty to 28 per cent of the oil of the seed is removed by warm pressure and seven per cent remains in the pressed residue. This oil is known as lin-

seed oil, and after being refined is used in the preparation of paints, varnishes, printer's ink, and in the manufacture of soap. The pressed cake is dried, cracked and ground, and furnishes the old process linseed meal. In case of the new process linseed meal, a particular brand of which is known as flaxmeal, the oil is quite thoroughly extracted from the crushed seeds by means of naphtha, and after the extraction, the meal is treated with steam, which removes the solvent and tends to produce a coarse flaky product.

Linseed meals are generally known as oil meals. This is an incorrect name, the oil having been removed to a considerable extent.

GLUTEN PRODUCTS.

The various products known as gluten meal, gluten feed, germ feed and the like, are the residues from the manufacture of starch and glucose (grape sugar) from maize or Indian corn.

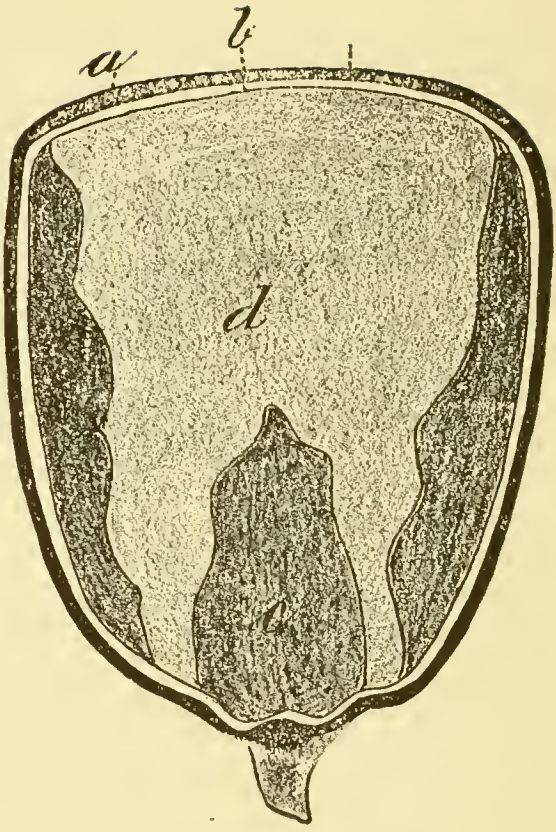
The average of a large number of analyses of water-free Indian corn shows it to have the following composition:

Ash,	1.7 per cent.
Protein,	11.5 per cent.
Fiber,	2.5 per cent.
Extract matter (chiefly starch),	78.9 per cent.
Fat,	5.4 per cent.

It is apparent that the corn is made up chiefly of starchy matter. The removal of the larger part of the starch naturally increases the proportion of the other ingredients. The constituent of the corn next in amount to starch is protein,—a general name for all albuminoids. In case of corn it is called gluten, and the feeds have been termed gluten feeds. Even in the best methods of separation, the starch is not all removed, the residues often being made up of one-half starchy matter.

Parts of Indian Corn.—The accompanying enlarged cut* of a maize kernel will assist in locating the four distinct parts which are of interest in this study.

*This cut and description were taken from Bulletin 105 of the New Jersey Experiment Station.



a is the husk or skin covering the whole kernel; it consists of two distinct layers, the outer and inner, which when removed constitute the bran and contain practically all of the crude fiber of the whole grain.

b is a layer of gluten cells which lie immediately underneath the husk; it is, as a rule, yellow in color and cannot be readily separated from the remainder of the kernel. This part is richest in gluten.

c is the germ, which is readily distinguished by its position and form; it also contains gluten, though it is particularly rich in oil and mineral constituents.

The large portion (*d*) is composed chiefly of starch; the dark color indicates the flinty part in which the starch cells are most closely compacted.

How the parts are separated. The corn is first soaked in quite dilute, warm sulfurous acid water. It is then ground by being passed with water through mills to carry off the substance in suspension. Degerminating machinery removes the germs at this point. The germs are dried and crushed between rolls, and the oil pressed out, leaving the residue in cakes.

It is exported as *Corn Germ Cake* or sold in this country as *Germ Oil Meal.*

After degermination the suspended mass is bolted through sieves separating the hull, bran, and some light weight and broken germs from the starch and gluten. These materials pressed and dried were formerly sold as *Chop Feed*, but are now known as *Fancy Corn Bran.*

The starch and gluten are run into concentrating tanks and then

passed very slowly through long shallow troughs. The starch settles down like wet lime in these troughs, while the hard flinty portion or gluten floats off into receivers, is concentrated, and finally pressed in heavy filter cloths, run through steam dryers, and appears as *Gluten Meal.*

The gluten meal and more or less of the corn bran mixed together, pressed and dried, constitutes *Gluten Feed.*

Class II.

Gluten Feeds. (See above.)

Distillers' dried grains consist of the residue in the process of manufacturing alcohol, spirits, and whiskey, from the several cereals. Briefly stated, the process consists in grinding the various grains employed and heating them with a solution of malt, thus converting the starch into sugar. The addition of yeast converts the sugar into alcohol, which is then distilled and the residue or distillery slop is filtered, dried in especially constructed driers and put upon the market as a cattle food. If consists chiefly of the hull, germ and protein of the grains. It has a more or less sour taste and smell, because of the fermentation. If the slop remains undried too long, this sour condition is increased.

Brewers' dried grains is the kiln-dried residue from beer manufacture. It consists of some of the starch, together with the hull, germ and gluten of the barley. A small portion of the gluten and the larger part of the starch are removed from the barley by the action of diastase and yeast.

Malt sprouts. Malt used in beer manufacture is prepared by moistening barley and allowing it to sprout. The sprouting produces a ferment called diastase, which changes the starch into sugar. After the formation of the diastase which requires a certain number of days, the barley is dried, and the sprouts removed by machinery and sold for cattle feed. The barley is now termed malt.

Class III.

THE WHEAT KERNEL.*

(A). Germ containing gluten, starch, and particularly rich in oil and mineral matters.

(B). Starch cells composing the larger portion of the inner parts of the kernel.

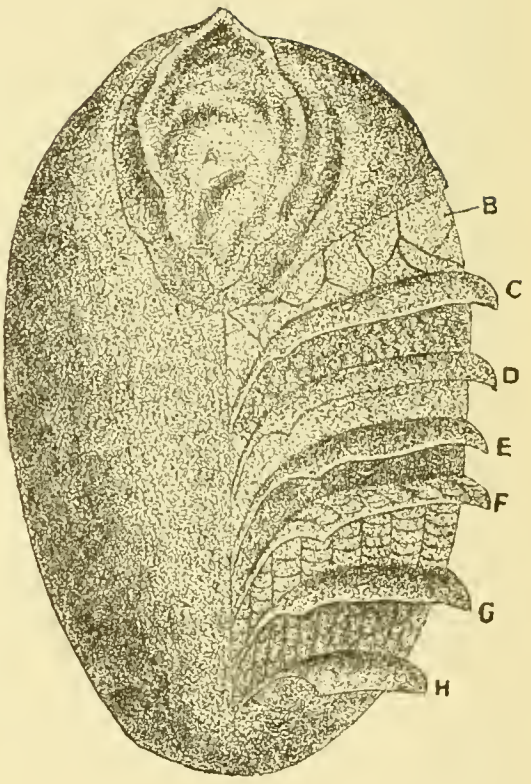
(C). Gluten cells which lie directly beneath the husk, and being especially rich in gluten.

(D). Inner coat of the bran.

(E). Coloring matter of the bran.

(F and G). Outer coats of bran.

(H). Epidermis or exterior covering of kernel.



MILLING PROCESS OF WHEAT.*

The wheat first passes over a series of metallic sieves, which remove oats, straw, mustard seeds, and other impurities. It then enters an upright rapidly whirling cylinder or scourer, and is thoroughly beaten and brushed, thus removing all dust and dirt. The perfectly clean wheat is crushed by passing between corrugated rolls, and then enters long reels covered with coarse bolting cloth. This crushing and sifting process is repeated five times, and the several siftings not passing through the cloth constitute the *wheat bran*. The portions passing through the coarse bolting cloth are still further treated by repeatedly running them between rollers, into revolving reels covered with silk bolting cloth of various degrees of fineness, and by currents of air, and are by these means separated into *shorts* or *standard middlings*, *flour middlings*, *red dog flour*, and

*From a description published by the Washburn Crosby Co.

the *fine white flour* for domestic uses. At a certain stage in this latter process the germ—more tough and elastic than the gluten or starch and not so easily crushed—is removed from the mixture and is utilized as a breakfast cereal.

In the various reductions as above described,about 70 per cent of the grain is saved for human food, and 30 per cent becomes bran, middlings, etc.

WHEAT OFFAL.

Bran, or the outside coverings of the kernel contains about 16 per cent of protein, in addition to ash, fat, fiber, and starchy matter.

Standard middlings may be defined as the finer portion of the bran mixed with rather more starchy matter.

Red dog—a low grade flour—represents the dividing line between the middlings and the high grade flour. It is rich in gluten, containing 20 per cent or more of protein.

Flour middlings consist of a mixture of the finer portion of the middlings, and more or less red dog flour. They contain 18 to 20 per cent of protein, and are more digestible than either the bran or coarse middlings.

Mixed feed, so called, is generally the entire wheat offal: a mixture of bran, standard and flour middlings. The proportions of the several materials in such a mixture vary considerably, the bran constituting the larger part.

H-O dairy feed—also belonging to Class III—consists of oat offal and light oats as a basis, together with some corn, and fortified with wheat bran and cottonseed or gluten meal.

Class IV.

Cerealine feed. This feed comprises the hull, and some of the starch of the corn. It is the by-product resulting in the manufacture of the breakfast preparation known as cerealine flakes. It is very coarse. It possesses a feeding value but slightly inferior to corn meal.

Hominy meal or hominy, as used for human food, represents the hard part of the corn kernel. The separation of the hull, germ, and

some of the gluten and starch which constitutes the cattle feed, is said to be brought about solely by the aid of machinery and steam.

Corn bran formerly known as *chop feed* has been referred to under gluten products.

Quaker dairy feed consists of the better grades of oat offal as a basis, fortified with some material rich in protein.

Oat feed, corn and oat feed, and provender. Oat feed is the refuse from factories engaged in the preparation of oat meal and other cereals for human consumption. It consists of poor oats, hulls, and some of the bran and starch removed in the process of manufacture. It is frequently mixed with corn, and sold as corn and oat feed, or as provender. True provender is a mixture of cracked corn and oats and should contain at least 10 per cent of protein and 4 per cent of fat. It should not be confused with the numerous mixtures of oat offal and corn sold under a similar name.

H-O Horse feed resembles the dairy feed in its general make-up, excepting that linseed meal takes the place of the cottonseed in the mixture. The manufacturers evidently intend to make it somewhat similar to oats in chemical composition.

WEIGHT OF CONCENTRATES.

Kind of Feed.	One Quart Equals:	One Pound Equals:
Cottonseed Meal.	1.4 pounds.	0.71 quarts.
Linseed Meal, old process.	1.1 "	0.90 "
Gluten Meal,	1.8 "	0.55 "
Gluten Feed.	1.3 "	0.71 "
Germ Oil Meal,	1.4 "	0.71 "
Brewers' Grains,	0.6 "	1.70 "
Malt Sprouts,	0.6 "	1.70 "
Wheat Bran,	0.5 "	2.00 "
Wheat Middlings, standard,	0.8 "	1.25 "
Wheat Middlings, flour,	1.2 "	0.83 "
Corn Kernels,	1.7 "	0.60 "
Corn Meal,	1.5 "	0.70 "
Corn and Cob Meal,	1.4 "	0.67 "
Corn Bran,	0.5 "	2.00 "
Oat Kernels,	1.1 "	0.90 "
Oats (ground.)	0.7 "	1.40 "
Wheat Kernels,	1.9 "	0.53 "
H-O Dairy Feed,	0.7 "	1.43 "
Quaker Dairy Feed,	1.0 "	1.00 "
Victor Corn and Oat Feed,	0.7 "	1.43 "

E. PROTEIN STANDARD.

	FEED STUFF.	PROTEIN STANDARD.
Protein Feeds.	*Cottonseed meal.*	43 per cent.
	N. P. linseed meal.	37 "
	O. P. linseed meal.	35 "
	Gluten meal.	34–38 "
	Gluten feed.	25 "
	Wheat middlings (flour).	18–20 "
	Wheat middlings (standard).	17–19 "
	Mixed feed.	16–17 "
	Wheat bran.	15–16 "
	Malt sprouts.	25 "
	Dried brewers' grains.	22 "
	H-O dairy feed.	18 "
Starchy (Carbohydrate) Feeds.	*Corn meal.*	9 "
	Hominy meal.	10–11 "
	Ground oats.	11–12 "
	Oat feed (best grade).	7– 9 "
	Oat feed (excessive hulls).	4– 7 "
	Quaker dairy feed.	12 "
	Corn and oat feed.	8– 9 "
	Corn, oat, and barley feed.	11–12 "
	H–O horse feed.	12 "
Poultry Feeds.	*American poultry feed.*	13 "
	H–O poultry feed.	17 "
	H–O scratching feed.	11–12 "
	Clover meal.	12 "
	Meat and bone meal.	40 "
	Meat scrap.	50 "

F. RESULTS OF INSPECTION.

I. Protein Feeds.

Cottonseed Meal.

Brand.	Manufactured by:	Sampled at:	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat. %
	The American Cotton Oil Co.	Amherst	43.00	9.00			
	" "	Greenfield	43.00	9.00			
	" "	Greenfield	43.00	9.00			
	" "	Lawrence	43.00	9.00	7.01	44.71	9.94
	" "	Needham	43.00	9.00			
	" "	Springfield	43.00	9.00			
	" "	Springfield	43.00	9.00			
Canary	R. W. Biggs & Co.	Amherst	43.00	9.00			
"	" "	Beverly	43.00	9.00			
"	" "	Palmer	43.00	9.00	7.57	45.45	9.41
"	" "	Westboro	43.00	9.00			
	Booker & Gentry	Leominster	43.00	9.00	6.50	46.59	8.33
	" "	Northboro	43.00	9.00			
Owl	F. W. Brodé & Co.	Fall River	43.00	9.00			
"	" "	Lexington	43.00	9.00	6.54	45.81	9.57
"	" "	Northampton	43.00	9.00			
Green Diamond	Chapin & Co.	Chester	43.00	9.00			
"	" "	Shelburne Falls	43.00	9.00	8.01	44.57	9.85
"	" "	Waltham	43.00	9.00			
	" "	Brockton	43.00	9.00			
	" "	Fitchburg	43.00	9.00			
	" "	Fitchburg	43.00	9.00			
	" "	Gardner	43.00	9.00			
	" "	Haverhill	43.00	9.00			
	" "	Newburyport	43.00	9.00	6.94	46.24	9.34
	" "	Newburyport	43.00	9.00			
	" "	Shelburne Falls	43.00	9.00			
	" "	S. Amherst	43.00	9.00			
	" "	Springfield	43.00	9.00			
	" "	Taunton	43.00	9.00			
Cofco	The Cotton Oil & Fibre Co.	Easthampton	43.00	9-10	6.64	49.01	8.56
"	" "	Holyoke	43.00	9-10			
	Chas. M. Cox & Co.	Sunderland	—	—	6.34	43.63	8.75
Jersey	Decatur Cotton Oil Co.	New Bedford	43-48	9-12	5.24	46.20	11.01
"	" "	Wakefield	43-48	9-12			
	J. G. Falls & Co.	Shelburne Falls	41-43	9-10			
	" "	S. Deerfield	41-43	9-10	6.35	45.06	9.61
	" "	Westfield	41-43	9-10			
	Georgia Cotton Oil Co.	Athol	41.00	—	6.67	45.59	8.36
	Hayley & Beine	Fall River	43.00	9-10	7.18	46.16	10.69
	" "	Worcester	43.00	9-10			
Dixie	Humphreys. Godwin & Co.	Adams	43.00	9.00			
"	" "	Lawrence	43.00	9.00			
"	" "	N. Wilbraham	43.00	9.00	6.23	45.94	9.50
"	" "	S. Framingham	43.00	9.00			
	Hunter Bros.	S. Deerfield	43.00	9.00			
	" "	S. Framingham	43.00	9.00			
	" "	Worcester	43.00	9.00	6.80	45.19	9.83
	" "	Worcester	43.00	9.00			

(Continued.)

Cottonseed Meal (continued).

Brand.	Manufactured by:	Sampled at:	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat.
	Independent Oil Co.	Springfield	43.00	9-10	6.25	45.81	9.68
	Sledge & Wells Co.	N. Adams	—	—	6.92	45.94	9.78
	" "	Wakefield	43.00	9-10			
	J. E. Soper & Co.	Holyoke	43.00	9-10			
	" "	Lawrence	43.00	9-10			
	" "	Palmer	43.00	9-10	7.39	44.36	9.14
	" "	Pittsfield	43.00	9-10			
	" "	S. Deerfield	43.00	9-10			
Star	The Star Co.	Gt. Barrington	43.00	9-10	5.32	45.81	9.95
"	" "	Southbridge	43.00	9-10			
	Uniontown Cotton Oil Co.	Waltham	—	—	7.03	45.06	9.97
	Unknown	Danvers	43.00	9.00	8.44	46.46	11.11
	"	Millbury	43.00	9.00	5.61	46.42	9.10
	"	Newton Highlands	—	—	8.37	44.05	7.30
	"	Orange	43.00	9.00	6.65	46.64	9.81
	"	Pittsfield	—	—	8.43	44.75	10.59
	"	Springfield	—	—	6.00	45.72	10.43
	Slightly Inferior—below standard.						
	Unknown	Fitchburg	—	—	5.58	42.06	16.67
	"	Orange	—	—	5.92	42.38	10.20
	"	Pittsfield	—	—	8.41	41.15	7.80
	Highest				**8.44**	**49.01**	**11.11**
	Lowest				**5.24**	**41.15**	**7.30**
	*Average				**6.86**	**45.60**	**9.57**

Linseed Meal.

Brand.	Manufactured by:	Sampled at:	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat. %
	New Process.						
Cleveland Flax	American Linseed Co.	Southboro	—	—	9.06	38.21	2.22
" "	" "	Southboro	—	—			
" "	" "	Wakefield	—	—			
	" "	Amherst	38-40	1-3	10.54	38.75	2.10
	" "	Pittsfield	—	—	8.67	34.80	3.59
	" "	Worcester	—	—	9.52	36.33	2.76
	E. A. Crosby	Amherst	—	—	9.54	36.73	1.42
	Prentiss, Brooks & Co.	Northampton	—	—	9.10	37.20	1.56
	Unknown	Springfield	—	—	9.36	40.06	2.12
	"	Woburn	—	—	9.30	36.86	1.37
	Average				**9.32**	**37.54**	**2.16**
	Old Process.						
	American Linseed Co.	Concord	32-36	5-7	8.38	33.48	6.76
	" "	Northboro	32-36	5-7			
	" "	Pittsfield	32-36	5-7			
	" "	Springfield	—	—			
Saturn	Chapin & Co.	Northampton	—	—	8.62	27.73	7.52
"	" "	Winchendon	—	—			
	Hunter Bros.	Southbridge	—	—	8.20	34.31	8.75
	Kellogg & Miller	Pittsfield	36.70	7.83	8.11	37.64	9.06
	" "	Pittsfield	36.70	7.83			

* Inferior and adulterated brands not included in averages.

(Continued.)

Linseed Meal (continued).

Brand.	Manufactured by:	Sampled at:	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat. %
	Midland Linseed Oil Co.	Amherst	—	—			
	" "	Gardner	—	—			
	" "	Greenfield	—	—			
	" "	Leominster	—	—	9.85	32.60	7.25
	" "	New Bedford	—	—			
	" "	N. Wilbraham	—	—			
	Union Linseed Oil Co.	N. Adams	—	—	12.75	31.11	6.95
Square	Unknown	Fitchburg	—	—			
"	"	Northampton	—	—	9.72	29.80	6.31
"	"	S. Framingham	—	—			
	"	Chester	—	—	8.63	33.75	6.41
	"	Lawrence	—	—	9.28	29.31	6.29
	"	Worcester	—	—	9.01	31.64	6.32
	Average				**9.23**	**32.26**	**7.15**

Gluten Meal.

Brand.	Manufactured by:	Sampled at:	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat. %
Chicago	The Glucose Sugar Refining Co.	Chicopee	39.50	3.37			
"	" "	Fall River	39.50	3.37			
"	" "	Gardner	39.50	3.37			
"	" "	Holyoke	39.50	3.37			
"	" "	Leominster	39.50	3.37			
"	" "	N. Adams	39.50	3.37	8.41	36.50	3.25
"	" "	N. Adams	39.50	3.37			
"	" "	Pittsfield	—	—			
"	" "	Taunton	39.50	3.37			
"	" "	Winchendon	39.50	3.37			
"	" "	Worcester	39.50	3.37			
"	" "	Athol	39.00	2.00			
"	" "	Holyoke	39.00	2.00			
"	" "	New Bedford	39.00	2.00			
"	" "	S. Weymouth	39.00	2.00	8.67	33.71	3.60
"	" "	Springfield	39.00	2.00			
"	" "	Taunton	39.00	2.00			
"	" "	Woburn	39.00	2.00			
Cream	Chas. Pope Glucose Co.	Fitchburg	34.12	3.20			
"	" "	Lawrence	34.12	3.20			
"	" "	Millbury	34.12	3.20			
"	" "	New Bedford	34.12	3.20			
"	" "	Newburyport	34.12	3.20			
"	" "	N. Adams	34.12	3.20	9.26	35.67	2.68
"	" "	Northampton	34.12	3.20			
"	" "	Pittsfield	34.12	3.20			
"	" "	Southbridge	34.12	3.20			
"	" "	Woburn	34.12	3.20			
"	" "	Worcester	34.12	3.20			
King	The National Starch Mfg. Co.	Middleboro	35.60	4.28	8.62	34.53	3.17
"	" "	Middleboro	35.60	4.28			
	Inferior—excess of oil.						
	The American Cereal Co.	Adams	—	—	6.15	21.32	18.10
	Average				**8.78**	**35.45**	**3.12**

Gluten Feed.

Brand.	Manufactured at :	Sampled at :	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat. %
Buffalo	The Glucose Sugar Refining Co.	Amherst	28-30	3-5			
"	" "	Amherst	28-30	3-5			
"	" "	Danvers	28-30	3-5	8.66	27.25	3.62
"	" "	Danvers	28-30	3-5			
"	" "	Needham	28-30	3-5			
"	" "	Haverhill	27.50	3.30			
"	" "	Haverhill	27.50	3.30			
"	" "	Leominster	27.50	3.30	9.06	27.25	3.40
"	" "	Leominster	27.50	3.30			
"	" "	Holyoke	25.50	4.00			
"	" "	Southbridge	25.50	4.00			
"	" "	S. Framingham	25.50	4.00	8.24	26.90	3.20
"	" "	Westfield	25.50	4.00			
"	" "	Lynn	—	—	9.84	25.58	3.38
Davenport	" "	Gt. Barrington	27.50	3.30	8.96	25.62	3.90
"	" "	S. Framingham	27.50	3.30			
"	" "	Gt. Barrington	25.50	4.00			
"	" "	Palmer	—	—			
"	" "	Palmer	—	—	9.52	25.05	3.28
"	" "	Worcester	—	—			
Marshalltown	" "	Adams	27.00	3.00			
"	" "	N. Amherst	—	—	8.27	28.13	3.44
"	" "	Winchendon	—	—			
Sunshine	Illinois Sugar Refining Co.	Southboro	27.50	3.30	7.19	26.85	3.74
	The National Starch Mfg. Co.	S. Deerfield	31.70	4.30	8.46	26.95	3.34
	" "	Shelburne Falls	28.40	4.30	7.90	25.80	3.98
	" "	Wakefield	28.40	4.30			
	Noyes & Colby	Concord	—	—	6.67	25.23	3.28
Waukegan	U. S. Sugar Refining Co.	Amherst	27.38	3.39			
"	" "	Fitchburg	27.38	3.39			
"	" "	Marlboro	—	—			
"	" "	Newburyport	—	—	8.87	25.14	4.05
"	" "	N. Wilbraham	27.38	3.39			
"	" "	Southboro	—	—			
"	" "	Springfield	27.38	3.39			
	Unknown	Greenfield	—	—	7.51	26.06	4.47
	"	Natick	—	—	9.27	27.16	2.95
	Slightly Inferior—below standard.						
Buffalo	The Glucose Sugar Refining Co.	Natick	—	—	8.54	22.64	3.20
Pekin	Illinois Sugar Refining Co.	Ware	27.50	3.30	6.84	23.17	2.91
	The National Starch Mfg. Co.	Fitchburg	17.40	2.60	8.38	21.55	5.15
Daisy	Henry A. Russell	Adams	—	—	9.12	17.20	1.98
Imperial	Unknown	Weymouth	—	—	9.19	20.75	4.69
	Highest				**9.84**	**28.13**	**5.15**
	Lowest				**6.67**	**17.20**	**1.98**
	Average				**8.65**	**26.33**	**3.60**

Germ Oil Meal.

Brand.	Manufactured by :	Sampled at :	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat. %
	The Glucose Sugar Refining Co.	Chester	25.50	10.50			
	" "	Holyoke	25.50	10.50			
	" "	Lawrence	25.50	10.50			
	" "	New Bedford	25.50	10.50			
	" "	N. Wilbraham	25.50	10.50			
	" "	N. Wilbraham	25.50	10 50	8.58	21.85	10.20
	" "	Wakefield	25.50	10.50			
	" "	Wakefield	25.50	10.50			
	" "	Wakefield	25.50	10.50			
	" "	Westfield	25.50	10.50			
	" "	Springfield	—	—			

Wheat Middlings.

Brand.	Manufactured by:	Sampled at:	Moisture. %	Protein. %	Fat. %
Badger	Berger-Anderson Co.	Athol	10.43	20.14	5.81
"	" "	Newton Highlands			
Red Dog Flour	Chapin & Co.	Amherst	10.30	20.27	5.02
Dexter Feed	" "	Winchendon	11.29	18.38	4.98
Monogram	Chas. M. Cox & Co.	Lawrence	10.27	18.51	5.25
Puritan	" "	Chicopee	9.66	17.86	4.41
Daisy Flour	Daisy Roller Mills	Springfield	11.10	17.99	4.36
Best	J. G. Davis Co.	Gt. Barrington	10.10	18.30	5.37
Davis	" "	Gt. Barrington			
Chester	R. J. Hardy & Sons	Westfield	11.12	21.90	4.91
	Hollister, Chase & Co.	Amherst	9.87	18.42	4.70
Hunter's Feed	Hunter Bros.	Ware	11.66	17.34	3.11
Fancy Shorts	Minnesota Mill Co.	Springfield	11.22	18.92	4.90
XXX Comet	Northwestern Consol. Milling Co.	Chicopee	10.52	20.36	4.55
" "	" "	N. Adams			
" "	" "	Worcester			
Flour	" "	N. Adams	10.21	19.53	5.13
"	" "	N. Adams			
	" "	Amherst	9.80	17.77	5.10
	" "	Beverly			
	" "	E. Braintree			
	" "	Millbury			
	" "	Palmer			
	" "	Palmer			
	" "	Webster			
XX Daisy	C. A. Pillsbury	Fall River	10.02	20.67	4.86
" "	" "	Haverhill			
" "	" "	Natick			
" "	" "	N. Adams			
" "	" "	Northboro			
" "	" "	Springfield			
A	" "	Athol	9.38	20.36	5.83
B	" "	Holyoke	9.89	17.86	5.08
"	" "	S. Framingham			
Brown	" "	Springfield			
B	" "	Waltham			
"	" "	Woburn			
	" "	E. Brookfield	10.42	18.60	5.80
	Red Lake Falls Milling Co.	Waltham	11.38	18.38	3.85
Flour	The Sheffield Milling Co.	Easthampton	10.23	20.79	5.51
"	" "	Fitchburg			
Fancy	" "	Rockland			
Standard	" "	Taunton	10.60	19.44	4.79
Stott's White	David Stott	Holyoke	10.66	16.99	4.43
	Thompson Milling Co.	Athol	11.32	19.04	5.37
Fancy	The Geo. Tileston Milling Co.	Holyoke	11.20	19.18	4.63
Choice Winter	Valley City Milling Co.	Adams	10.23	16.99	4.49
" "	" "	Lowell			
" "	" "	Newburyport			
" "	" "	Newburyport			
Adrian Red Dog	Washburn Crosby Co.	Greenfield	10.33	21.50	5.55
Red Dog	" "	Amherst	10.45	19.53	5.16
Flour	" "	Amherst			
Standard	" "	Haverhill	10.16	19.09	5.65
"	" "	N. Amherst			
"	" "	Shelburne Falls			
"	" "	Weymouth			

(Continued.)

Wheat Middlings (continued).

Brand.	Manufactured by:	Sampled at:	Moisture. %	Protein. %	Fat. %
Snow's Cream Fl.	E. S. Woodworth & Co.	Adams			
" "	" "	Ware	10.07	20.36	4.69
" "	" "	Westfield			
	Unknown	Athol	10.49	18.74	4.34
	"	E. Weymouth	9.72	17.37	5.09
No. 1 Winter	"	Fitchburg	11.08	17.37	3.31
Coarse	"	Lawrence	10.19	17.07	5.05
	"	N. Adams	9.49	17.95	5.40
Red Dog	"	Taunton	10.67	21.20	5.56
	Slightly Inferior—below standard.				
	The Fenton Milling Co.	Westboro	10.82	16.59	4.33
White	Hart Bros.	Salem	10.32	15.49	4.75
	The Holly Milling Co.	Fitchburg	9.95	16.76	4.42
	" "	Worcester			
	The Voigt Milling Co.	Webster	11.58	16.59	3.68
	Unknown	Weymouth	9.76	15.76	4.20
	Highest		**11.66**	**21.90**	**5.81**
	Lowest		**9.38**	**15.49**	**3.11**
	Average		**10.27**	**19.01**	**5.15**

Mixed Feed.

Brand.	Manufactured by:	Sampled at:	Moisture. %	Protein. %	Fat. %
Acme	Acme Milling Co.	Athol			
"	" "	Chester			
"	" "	Fall River			
"	" "	Natick			
"	" "	Natick	9.04	17.33	4.62
"	" "	Shelburne Falls			
"	" "	Springfield			
"	" "	Springfield			
"	" "	Taunton			
Buckeye	The American Cereal Co.[1]	Athol			
"	" "	Gt. Barrington			
"	" " [1]	Lowell	8.91	17.72	4.37
"	" " [1]	Natick			
"	" "	Westfield			
	Ansted & Burk Co.	Lowell	8.90	16.67	4.22
	" "	Lowell			
Bay State	Bay State Milling Co.	Greenfield			
"	" "	Leominster	8.83	18.47	4.04
"	" "	Newburyport			
"	" "	Northboro			
Badger	Berger-Anderson Co.	N. Wilbraham	7.89	18.16	4.51
"	" "	S. Deerfield			
Winter Wheat	The Blish Milling Co.	Fitchburg	8.67	16.67	4.97
" "	" "	Middleboro			
	Brooks, Griffith Co.	Westboro	10.06	18.56	4.78
Burrough's Venus	Burrough & McEwen	Leominster	8.42	18.07	4.61
	Chamberlain	Worcester	7.82	17.29	4.56
Durham	Geo. C. Christian	Newburyport	6.60	17.99	5.63
	Cook	Southbridge	9.41	17.77	4.58
Columbia	Chas. M. Cox & Co.	Chicopee	7.74	18.56	5.20

(Continued.)

1 Guaranty Protein 16.21% Fat 4.48%

Mixed Feed (continued).

Brand.	Manufactured by:	Sampled at:	Moisture. %	Protein. %	Fat. %
Jersey	Chas. M. Cox & Co.	Easthampton			
"	" "	Haverhill			
"	" "	Haverhill			
"	" "	Lawrence			
"	" "	Leominster			
"	" "	Marlboro	8.15	18.07	4.87
"	" "	Natick			
"	" "	Rockland			
"	" "	Wakefield			
"	" "	Wakefield			
Monogram	" "	Fall River	6.90	17.81	4.65
No. 43	" "	Westfield	7.60	16.02	5.08
	" "	Lovell	10.14	17.33	4.50
	E. Crosby & Co.	Amherst	8.56	18.30	4.88
Royal	J. Cushing & Co.	Fitchburg			
"	" "	Shelburne Falls	7.58	16.02	4.51
Defiance	Defiance Milling Co.	Worcester	9.65	16.67	4.09
Royal	Doten Grain Co.	Haverhill	7.06	18.03	4.98
Hoosier Mill	Geo. T. Evans	Chester			
" "	" "	New Bedford	8.10	17.37	4.53
" "	" "	Springfield			
	F. & M. Co.	Lawrence	7.36	17.03	4.80
	G. E. M. Milling Co.	Middleboro	10.35	15.97	3.73
	" "	Rockland	7.93	16.85	4.68
Puritan	Grand Republic Mills	Salem	8.06	18.65	5.27
Berkshire	R. J. Hardy & Sons	Fitchburg	7.93	19.18	4.77
	The Isaac Harter Co.	Haverhill			
	" "	Lawrence	7 86	16.85	4.71
	" "	Worcester			
	Hollister, Chase & Co.	Taunton	9.75	16.02	4.60
	The Holly Milling Co.	Fitchburg	8.28	16.14	4.50
Excelsior	Hunter Bros.	Athol			
"	" "	Greenfield	9.36	16.59	4.24
"	" "	Holyoke			
Sunshine	" "	Webster			
"	" "	Worcester	9.57	17.81	4.58
	" "	Holyoke	8.55	17.46	4.46
Boston	Imperial Milling Co.	Clinton			
"	" "	Fall River			
"	" "	Holyoke			
"	" "	Holyoke			
"	" "	Newburyport			
"	" "	Newburyport	6.90	18.83	4.99
"	" "	Northboro			
"	" "	N. Wilbraham			
"	" "	S. Deerfield			
"	" "	Woburn			
	Kehlor Bros.	Haverhill			
	" "	Northboro	8.30	17.55	4.36
	" "	Orange			
Snowflake	The Lawrenceburg Roller Mills Co.	Chester			
"	" "	E. Braintree			
"	" "	Leominster			
"	" "	Lexington			
"	" "	Millbury	7.30	17.81	4.85
"	" "	Millbury			
"	" "	Northampton			
"	" "	Worcester			
"	" "	Worcester			

(Continued.)

Mixed Feed (continued).

Brand.	Manufactured by:	Sampled at:	Moisture. %	Protein. %	Fat. %
Hiawatha	Wm. Listman Milling Co.	Wakefield	9.31	18.12	5.21
	The Maumee Valley Milling Co.	Worcester	9.48	16.88	4.16
King	R. P. Moore Milling Co.	Worcester	8.93	18.12	4.41
New York	New York Mills	Gt. Barrington	9.73	16.50	4.73
Phoenix	Phoenix Milling Co.	Salem	7.32	19.44	4.87
" Fancy	" "	Woburn			
Fancy	C. A. Pillsbury	Adams	8.59	18.96	5.00
"	" "	Clinton			
"	" "	Gardner			
"	" "	Waltham			
"	" "	Worcester			
XXXX Patent	" "	Fall River	7.10	17.46	5.08
Vermont	Prentiss, Brooks & Co.	Westfield	6.89	17.46	4.64
Woronoco	" "	Westfield	7.32	18.78	5.15
Rex	The Rex Mill Co.	Amherst	8.75	17.86	4.56
"	" "	Danvers			
"	" "	Fitchburg			
"	" "	New Bedford			
"	" "	Southbridge			
Russell's	Henry A. Russell	Northboro	8.43	18.51	4.78
Fancy	" "	Shelburne Falls			
Russell's	" "	S. Framingham			
Choice	" "	Winchendon			
	S. M. Co.	S. Framingham	6.79	18.16	4.71
Dutchess	Schultz Baujan & Co.	Fitchburg	6.42	17.95	4.96
Gold Mine	The Sheffield Milling Co.	Rockland	8.99	18.69	5.29
Angola	Simpson Hendee & Co.[2]	Springfield	9.14	19.00	5.06
Lenox	" "	Worcester	9.13	18.12	4.45
Stott's	David Stott	Chicopee Falls	7.54	16.63	4.63
	Thorton & Chester Milling Co.	Westboro	7.17	18.07	5.57
Winter Wheat	Cow Valley City Milling Co.	Newburyport	9.54	16.14	4.54
	The Voigt Milling Co.	Webster	8.29	16.94	4.50
Superior	Washburn Crosby Co.	Amherst	8.07	18.42	5.06
"	" "	Athol			
"	" "	E. Brookfield			
"	" "	Greenfield			
"	" "	Natick			
"	" "	New Bedford			
"	" "	S. Deerfield			
	E. A. Witter	Newburyport	7.80	17.07	4.09
Flint	Unknown	Fitchburg	7.57	17.99	4.89
Kentucky	"	Orange	8.86	17.72	5.23
"	"	Taunton	8.39	16.90	4.76
"	"	Taunton	8.10	17.03	4.56
Royal	"	Leominster	9.09	16.10	4.39
Standard Spring	"	Springfield	10.86	17.55	4.90
Triple Extra	"	Worcester	8.73	17.66	4.94
	"	Amherst	8.73	18.16	4.89
	"	Easthampton	9.34	16.72	5.09
	"	Fall River	8.77	17.25	3.43
	"	Gt. Barrington	7.99	16.90	4.82
	"	Lawrence	8.82	16.14	4.50
	"	Leominster	8.02	19.31	5.60
	"	Lowell	10.00	19.97	4.52
	"	Lowell	7.70	15.93	4.37
	"	Lowell	8.35	16.59	4.49
	"	Lynn	7.41	17.99	4.99

(Continued.)

2 Guaranty Protein 16.61% Fat 5.48%

Mixed Feed (continued).

Brand.	Manufactured by:	Sampled at:	Moisture. %	Protein. %	Fat. %
	Unknown	Marlboro	7.21	19.74	4.38
	"	Middleboro	9.17	16.63	4.83
	"	Natick	8.90	16.46	4.74
	"	Needham	7.58	17.95	5.14
	"	New Bedford	9.86	19.44	2.86
	"	Southboro	10.25	19.00	4.58
	"	S. Framingham	7.31	17.90	4.59
	"	S. Weymouth	7.97	16.94	4.28
	"	Springfield	8.22	17.64	4.67
	"	Waltham	8.06	16.72	4.45
	"	Westfield	7.47	17.16	4.64
	"	Westfield	7.37	16.76	5.14
	"	Winchendon	9.78	17.95	5.44
	"	Woburn	7.71	17.60	4.90
	"	Worcester	8.90	16.06	3.74
	Slightly Inferior—below standard.				
	Lexington Roller Mills Co.	Haverhill	7.81	15.79	5.40
	" "	Lowell			
Lexington	" "	Shelburne Falls			
	Unknown	Brockton	7.76	15.67	4.43
	"	Lowell	9.17	15.79	4.76
	"	Millbury	7.48	15.05	4.61
	"	Southboro	8.07	15.05	5.11
	Adulterated.				
Jersey	The Kentucky Milling Co.[3]	Brockton	7.08	12.51	3.51
"	" " " [3]	Chicopee Falls			
"	" " " [3]	Springfield			
Winter Wheat	A. B. McCrillis & Son	New Bedford	7.24	13.12	3.71
Kentucky	Unknown	Athol	8.12	12.73	3.43
"	"	N. Adams	6.51	10.67	3.26
	"	Athol	7.75	11.67	3.35
	"	Gardner	7.80	11.76	3.02
	"	Worcester	7.57	11.80	2.65
	Highest		**10.86**	**19.97**	**5.57**
	Lowest		**6.42**	**10.67**	**2.65**
	Average		**8.29**	**17.75**	**4.76**

Wheat Bran.

Brand.	Manufactured by:	Sampled at :	Moisture. %	Protein. %	Fat. %
Alma	Alma Roller Mills	Athol	9.31	16.41	4.62
Flakes	Barber Milling Co.	Lexington	8.34	17.86	5.52
Choice	Bay State Milling Co.	Athol	9.88	16.72	5.11
Badger	Berger-Anderson Co.	Adams	9.20	16.94	4.90
"	" "	Northboro			
"	" "	Salem			
Monogram	Chas. M. Cox & Co.	Lawrence	9.61	16.59	4.31
"	" "	Lawrence			
"	" "	Worcester			
Choice Cream	J. G. Davis Co.	Pittsfield	8.92	16.85	4.33
	A. M. Fish	Gardner	9.59	17.11	3.97
	The Isaac Harter Co.	N. Adams	7.98	16.32	4.28

(Continued.)

3 Guaranty Protein 11.56% Fat 3.65%

Wheat Bran (continued).

Brand.	Manufactured by:	Sampled at:	Moisture. %	Protein. %	Fat. %
Winter	Hunter Bros.	E. Braintree	8.21	16.50	4.47
	" "	Lowell			
	" "	Orange			
	" "	S. Framingham			
	" "	Ware			
	" "	Worcester			
	Kehlor Bros.	N. Adams	8.67	18.38	4.68
Spring	Listman Mill Co.	Newton Highlands	8.06	17.16	5.15
Fancy	Minnesota Milling Co.	Beverly	9.95	15.44	4.68
	Moseley & Motley Milling Co.	N. Adams	7.96	17.60	5.52
	Northwestern Consol. Milling Co.	Lawrence	8.59	16.72	2.78
	" "	S. Amherst			
	" "	Webster			
	C. A. Pillsbury	Athol	7.88	17.11	4.08
Pillsbury's	" "	Chicopee Falls			
	" "	New Bedford			
Spring	" "	Northboro			
	" "	Middleboro			
	" "	Southbridge			
	" "	Springfield			
	" "	Taunton			
	Red Lake Falls Milling Co.	Lawrence	6.98	18.83	5.13
	" "	Weymouth			
	Russell-Miller Milling Co.	E. Weymouth	9.77	18.83	5.13
Coarse	The Sheffield Milling Co.	Lowell	7.58	16.81	3.82
"	" "	Newburyport			
"	" "	Pittsfield			
"	" "	Taunton			
Star Winter	Star & Crescent Milling Co	N. Adams	8.57	17.42	4.16
	F. W. Stock	E. Brookfield	8.13	16.02	4.50
	Stratton & Co.	Lexington	7.46	17.03	4.83
	" "	Lexington			
Pure Winter	David Stott	Chicopee Falls	8.23	16.10	4.46
" "	" "	Concord			
" "	" "	Holyoke			
Fancy	The Geo. Tileston Milling Co.	Amherst	8.39	16.41	4.81
	Urban Milling Co.	Webster	8.68	16.41	5.08
Michigan Winter	Valley City Milling Co.	Lowell	8.63	15.75	4.15
Pure Winter	Voigt Milling Co.	Northampton	8.20	16.76	3.93
Coarse	Washburn Crosby Co.	Amherst	8.28	17.29	5.21
"	" "	Clinton			
"	" "	Holyoke			
"	" "	Needham			
"	" "	New Bedford			
"	" "	Springfield			
Snow's Flaky	E. S. Woodworth & Co.	Danversport	8.06	16.72	4.93
"	" "	Easthampton			
"	" "	Marlboro			
"	" "	Pittsfield			
"	" "	Weymouth			
"	" "	Winchendon			
White Swan	Unknown	Palmer	8.59	16.76	4.76
Winter	"	Fitchburg	9.40	17.81	4.23
	"	Greenfield	9.31	16.85	4.96
	"	Holyoke	9.41	16.85	5.02

(Continued.)

Brand.	Manufactured by:	Sampled at:	Moisture. %	Protein. %	Fat %
	Unknown	Middleboro	8.15	17.72	5.2
	"	New Bedford	9.07	17.07	4.3
	"	New Bedford	7.77	17.60	4.6
Canada Winter	"	Northampton	8.43	15.18	4.4
	"	N. Wilbraham	8.78	16.94	5.0
	"	Palmer	8.24	15.32	4.8
Winter	"	Southbridge	9.13	17.20	4.4
	"	Westfield	8.53	18.34	4.4
Canada	"	Westboro	9.15	17.29	2.4
	Inferior—below standard.				
Canada Winter		Salem	9.08	12.81	4.2
Canada White		Worcester	8.48	13.30	4.7
	Highest		**9.77**	**18.83**	**5.5**
	Lowest		**7.46**	**12.81**	**2.4**
	Average		**8.41**	**16.88**	**4.5**

Miscellaneous Feeds.

Brand.	Manufactured by:	Sampled at:	Guaranteed. Protein %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat %
Dried Distillers' Grains	Unknown	Danvers	—	—	7.30	28.48	7.7
Malt Sprouts	Chas. M. Cox & Co.	Danversport	—	—	9.91	27.20	1.1
" "	" "	Wakefield	—	—			
" "	Unknown	Danvers	—	—	8.00	28.52	1.2
" "	"	Newburyport	—	—	9.09	29 27	1.21
" "	"	Waltham	—	—	10.85	26.81	1.1
Sucrene Oil Meal	American Milling Co.	S. Framingham	25.00	3.50	7.92	22.02	2.5
Sucrene Dairy Feed	" "	Lawrence	—	—	6.35	17.90	2.51
" "	" "	Natick	16.50	3 50			
H-O Dairy Feed	The H-O Co.	Brockton	18.00	4.50			
" "	" "	Greenfield	18.00	4.50			
" "	" "	Lowell	18.00	4.50			
" "	" "	Lynn	18.00	4.50	7.06	18.96	3.87
" "	" "	Pittsfield	18.00	4 50			
" "	" "	Springfield	18.00	4.50			
" "	" "	Worcester	18.00	4.50			
Bean Meal	F. M. Vietor	Lawrence	—	—	10.46	24.31	1.21
Green Pea Meal	" "	Lawrence	—	—	10.04	26.06	1.65

II. Starchy (Carbohydrate) Feeds.

Corn Meal.

Brand.	Manufactured by:	Sampled at:	Moisture. %	Protein. %	Fat. %
	H. W. Crowell	Newton Highlands	10.35	8.86	4.23
	J. W. Doon & Son	Natick	13.40	8.69	4.06
	" "	Natick	10.03	9.21	4.35
	J. L. Holly	Amherst	11.35	9 38	4.08
	W. H. Smith	Northampton	11.68	9.17	3.79
	" "	Northampton			
	E. W. Pierce*	Lawrence	22.09	9.09	0.48
Buckeye Fancy Bolted	Unknown	Marlboro	12.60	8.08	1.82
	Average		**11.42**	**9.08**	**4.05**

Hominy Meal.

Brand.	Manufactured by:	Sampled at:	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat. %
Niagara	Chapin & Co.	Fitchburg	11.00	8.00	7.20	11.19	9.05
"	" "	Shelburne Falls	11.00	8.00			
	Shellabarger Mill & Elev.Co.	Shelburne Falls	10.76	8.64	7.64	10.62	9.11
	Suffern, Hunt & Co.	Fitchburg	11.02	7.70	7.85	11.72	9.81
	" "	Salem	11.02	7.70			
	Unknown	Gt. Barrington	—	—	7.06	10.75	8.65
	"	Shelburne Falls	—	—	6.63	11.45	10.87
	"	Wakefield	—	—	7.53	11.19	7.83
	Average				**7.37**	**11.23**	**9.27**

Oat Feed.

Brand.	Manufactured by:	Sampled at:	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat. %
Vim	The American Cereal Co.	Athol	—	—	5.08	7.19	2.53
"	" "	Beverly	—	—			
"	" "	Beverly	—	—			
Banner	R. J. Hardy & Son	Fitchburg	—	—	5.20	7.63	2.89
Friend's Dairy	Muscatine Oat Meal Co.	Brockton	10.90	3.70	5.33	8.16	2.94
" "	" "	Middleboro	10.90	3.70			
" "	" "	Newburyport	10.90	3.70			
" "	" "	Wakefield	10.90	3.70			
" "	" "	Wakefield	10.90	3.70			
Dairy	Pillsb'y Washburn F.M.Co.	N. Wilbraham	7.09	2.85	6.02	7 02	2.65
"	" "	Orange	7.09	2.85			
"	" "	S. Framingham	7.09	2.85			
"	" "	Waltham	7.09	2.85			
	Average				**5.47**	**7.54**	**2.75**
	Low Grade—excessive hulls.						
Very Rich	Fish & Co.	N. Amherst	—	—	6.45	2.63	1.13
Oatena	The Illinois Cereal Co.	Danvers	—	—	5.39	4.78	1.32
"	" "	Lowell	—	—			
"	" "	Southboro	—	—			
Argyle Pure	The Gt.Western Cereal Co.	E. Weymouth	—	—	5.68	6.58	2.13
" "	" "	New Bedford	—	—			
" "	" "	Wakefield	—	—			
Cream	" "	Westboro	8.25	4.14	4.20	5.97	2.13
X	" "	Lawrence	—	—	5.43	1.45	0.58
Magnolia Gd. Oats	R. J. Hardy & Sons	Gardner	—	—	4.19	6.54	2.49
Linconshire Fancy	D. K. Reed & Sons	S. Deerfield	—	—	6.40	6.80	2.37
" "	" "	Westboro	—	—			
" "	" "	Woburn	—	—			
Boston	J. E. Soper & Co.	Lexington	—	—	6.34	4.26	1.46
"	" "	Worcester	—	—			
	Average				**5.69**	**5.31**	**1.65**

*Sour resulting from excess of moisture.

Quaker Dairy Feed.

Brand.	Manufactured by:	Sampled at:	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat. %
Quaker	The American Cereal Co.	Amherst	—	—			
"	" "	Fall River	—	—			
"	" "	Gardner	12.03	2.50			
"	" "	Lawrence	—	—			
"	" "	Natick	12.03	2.50	5.96	13.73	3.27
"	" "	Orange	12.03	2.50			
"	" "	Pittsfield	—	—			
"	" "	S. Amherst	12.03	2.50			
"	" "	Worcester	12.03	2.50			

Corn and Oat Feed—Provender.

Brand.	Manufactured by:	Sampled at:	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat. %
Victor	The American Cereal Co.	Chicopee Falls	8.23	3.00			
"	" "	Gardner	8.23	3.00			
"	" "	Lowell	8.23	3.00			
"	" "	N. Amherst	8.23	3.00			
"	" "	Salem	8.23	3.00	7.86	9.17	4.03
"	" "	S. Amherst	8.23	3.00			
"	" "	S. Weymouth	8.23	3.00			
"	" "	Taunton	8.23	3.00			
"	" "	Worcester	8.23	3.00			
	The Cutler Co.	Pittsfield			9.05	11.02	3.98
	Garland, Lincoln & Co.	Worcester			10.84	11.02	2.13
	W. H. Haskell & Co.	Lawrence	12.00	6.25			
Haskell's	" "	Lawrence	—	—			
	" "	Lowell	12.00	6.25			
	" "	Lynn	12.00	6.25			
Climax	" "	Salem	12.00	6.25	7.41	9.79	6.76
"	" "	Salem	12.00	6.25			
Climax Horse	" "	Salem	—	—			
Climax	" "	Wakefield	12.00	6.25			
Haskell's	" "	Woburn	12.00	6.25			
DeFi	The H-O Co.	Northboro	—	—			
"	" "	N. Wilbraham	8.30	3.00	7.88	8.60	2.46
"	" "	Taunton	—	—			
H-O Horse	" "	Brockton	12.00	4.50			
"	" "	Northboro	12 00	4.50			
"	" "	Pittsfield	12 00	4.50	8.69	12.38	3.07
"	" "	Salem	12.00	4.50			
	J. L. Holly	Amherst	—	—	10.46	10.88	4.09
	Hosmer & Green	Westfield	—	—	11.45	10 03	4.14
	J. S. Nason & Co.	Westboro	—	—	9.50	10.71	4.39
	Unknown	Worcester	9 00	5.00	7.00	9.97	2.62
	Slightly Inferior—below standard.						
Chester Stock	Chester Mills	Holyoke	11.50	4.20			
" "	" "	Holyoke	11.50	4.20	8.28	7.37	2.06
" "	" "	Westfield	11.50	4.20			
Sterling	M. L. Crittenden	Beverly	—	—			
"	" "	Beverly	—	—	7.43	6.76	2.70
"	" "	Haverhill	—	—			
	E. Crosby & Co.	Amherst	—	—	5.04	7.50	2.40
Purity Pinhead	Unknown	Leominster	—	—	7.36	6.14	2.10
	Highest				11.45	12.38	6.76
	Lowest				5.04	6.14	2.06
	Average				8.20	9.99	4.46

Corn, Oat and Barley Feed.

Brand.	Manufactured by:	Sampled at:	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fat. %
Schumacher's	The American Cereal Co.	Adams	10.79	3.28			
"	" "	Adams	10.79	3.28			
"	" "	Brockton	10.79	3.28			
"	" "	Fall River	10.79	3.28			
"	" "	Fall River	10.79	3.28			
"	" "	Fitchburg	—	—			
"	" "	Fitchburg	10.79	3.28			
"	" "	Holyoke	—	—	6.44	11.84	4.65
"	" "	Pittsfield	—	—			
"	" "	Pittsfield	10.79	3.28			
"	" "	Springfield	10.79	3 28			
"	" "	Waltham	10.79	3.28			
"	" "	Webster	—	—			
"	" "	Worcester	—	—			
"	" "	Worcester	—	—			

Miscellaneous Feeds.

Brand.	Manufactured by:	Sampled at:	Moisture. %	Protein. %	Fat. %
Cob Meal	E. H. Smith	Northboro	11.84	8.63	3.72
Graham Flour	Miner & Edgerton	Chicopee	11.13	12.34	1.94
Rye Meal	Oneonata Co.	Worcester	10 52	14.78	2.33
Rye Middlings	" "	Lawrence	10.93	14.57	3.16
N. Y. Wheat	Unknown	Adams	9.70	13.73	1.86
White Winter Wheat	"	Chicopee	10.19	10.40	1.67
Schumacher's Cr. Meal	The American Cereal Co.	Fall River	11.69	8.16	1.57
Mellen's Food Refuse	Mellen's Food Co.	Needham	6.11	14.57	3.83
" "	" "	Waltham			
Shredded Wheat Refuse	Natural Food Co.	Fitchburg	6.82	11.84	1.34
" "	" "	S. Weymouth			
Comb. Hay Feed "A"	Davis Feed Co.	Worcester	10.62	9.97	3.19

III. Poultry Feeds.

Brand.	Manufactured by:	Sampled at:	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. F: %
American	The American Cereal Co.	Chicopee Falls	—	—			
"	" "	Salem	—	—			
"	" "	Springfield	—	—	8.53	13.51	6.:
"	" "	Springfield	—	—			
"	" "	Wakefield	—	—			
Blended Grains	C. H. Felker & Co.	Brockton	—	—	11.48	11.67	2.1
H-O	The H-O Co.	Brockton	17.00	5.50			
"	" "	Fall River	17.00	5.50	8.14	17.60	5.:
"	" "	Wakefield	17.00	5.50			
Scratching Food	" "	Orange	—	—			
" "	" "	Springfield	—	—	8.92	12.34	4.(
Green's Chicken	Poultry & Farm Supply Co.	Amherst	—	—	10.00	15.69	4.(
Kaffir Corn	Ross Bros.	Westfield	—	—	9.47	10.79	3.1
Spratt's	Spratt	Salem	—	—	7.93	19.97	3.(
Clo.M'l "Pioneer"	The Bennett & Millet Co.	Salem	—	—	6.84	10.27	2.(
Clover Meal	Jordan Milling Co.	Northboro	—	—	6.29	11.37	2.1

Meat and Bone Meals.

Brand.	Manufactured by:	Sampled at:	Guaranteed. Protein. %	Guaranteed. Fat. %	Found. Moisture. %	Found. Protein. %	Found. Fa %
Meat & Bone	Beach Soap Co.	Clinton	—	—			
" "	" "	Gardner	—	—	4.07	24.22	9.9
" "	" "	Lawrence	—	—			
Animal	The Bowker Co.	Clinton	—	—			
"	" "	Greenfield	—	—	5.76	36.24	7.9
Swift's M'l & Bone	Lowell Fertilizer Co.	Lowell	—	—	6.47	58.71	11.6
Beef	Parmenter & Polsey	Wakefield	—	—	6.31	35.62	8.9(
Meat & Bone	The Rogers' Mfg. Co.	Webster	40-45	15-18	6.91	41.42	13.0(
Boil'd Beef & Bone	Smith & Roumaine	Newburyport	45	15			
" "	" "	Orange	—	—	4.77	40.76	21.3(
	Average,.....				5.30	36.24	12.2(
		Meat Scrap.					
	Beach Soap Co.	Lawrence	—	—	8.49	52.96	20.8
	The Bowker Co.	Winchendon	—	—	6.84	45.15	12.8]
	Darling Fertilizer Co.	Worcester	50	16	6.99	43.96	19.9;
Pure Beef	A. Ward & Co.	Fall River	—	—	7.04	48.83	19 0(
	Average.....				7.34	47.73	18.1[

G. DISCUSSION OF THE RESULTS.

I. Protein Feeds.

Cottonseed, Linseed and Gluten Products.

The cottonseed meal on sale the past year was rather above the average in composition. The lowest percentage of protein found was 41.15, and the average of the 69 samples showed 45.60 per cent of protein, equivalent to 7.3 of nitrogen. If purchasers will insist on having only guaranteed meals, this standard can surely be maintained.

Most of the old process linseed meal formerly contained 35 per cent of protein. The samples collected the past year averaged only 32.26 per cent, and a number of lots contained less than 30 per cent. A noticeable exception was the meal put out by Kellogg & Miller, which was guaranteed, and tested 37.6 per cent of protein—a per cent above the guaranty. The new process meal showed an average of 37.54 per cent protein. While it can hardly be said that the old process meals were adulterated, most of them were certainly below the average quality. The larger part of the linseed collected was not guaranteed.

The gluten meals examined were of good quality, although in many cases the guarantees were not met. A few samples of gluten feed were collected containing 17 to 22 per cent of protein, but the larger number showed 25 or more per cent.

Germ oil meal—the pulverized germ of the Indian corn—was of the usual good quality. Its protein guaranty of 25 per cent is too high, 22.65 per cent being found two years ago, and 21.85 per cent the past year. This meal should not be confused with linseed meal, sometimes spoken of as "oil meal."

Wheat Offal.

Wheat bran and *middlings* were fully up to the usual average in composition. Purchasers are advised, however, to give the preference to those articles branded with the names of reputable manufacturers, or to examine the article closely before buying, in order to note the quality.

Mixed feed, so called, consists of the entire wheat offal, or mixtures of bran, coarse and flour middlings. The larger the proportion of flour middlings the more valuable the feed. Different brands show noticeable variations in the proportion of the several ingredients.

The average percentage of protein found in the samples reported in the present bulletin is 17.75, against 17.00 a year ago. Most mixed feeds are entirely free from adulteration. A few samples were found containing a considerable quantity of ground corn cobs. Some were marked *Kentucky Milling Co.*, others *Kentucky*, and a few were unmarked. A number of other samples contained a noticeable amount of wheat screenings. Mixed feed containing cobs can generally be recognized by the hard woody nature of the material when chewed. A close inspection of the feed will reveal the presence of screenings. Consumers are *especially cautioned* against such feeds.

Farmers can obtain a *very desirable* mixed feed, by mixing equal parts by weight of bran and flour middlings or red dog flour. Such a feed will be decidedly preferable to many of the brands now on the market, and the cost will not be increased.

Malt Sprouts, etc. The samples of malt sprouts collected contained 27 to 29 per cent of protein, which is several per cent above the average. The prices at which they are usually offered render them one of the cheapest sources of protein.

H-O Dairy feed is as usual fully up to its guaranty and shows a very even composition from year to year. An average of seven samples recently collected showed 18.96 per cent protein, and 3.87 per cent fat.

II. Starchy Feeds.

Corn and Hominy Meals. Comparatively few samples of corn meal were collected for examination, there seeming to be no inclination to adulterate this article. Corn meal will vary more or less in quality, depending on the character of the corn from which it is derived. The samples of hominy meal examined were of the usual good quality. This feed averaged 10.87 per cent of protein, and 7.74 per cent of fat in 1899; 11.24 per cent of protein, and 8.93 per cent of fat in 1900; and 11.23 per cent of protein, and 9.27 per cent of fat in 1901.

Oat Offal. The better grades of these feeds contained 7 to 8 per cent of protein, and 20 per cent of fiber, the fiber percentage being indicative of fifty to sixty per cent of hulls. The lower grades contained from 1.45 to 6.80 per cent of protein. One brand with the attractive name of "Very

Rich," contained 2.63 per cent of protein, another with the aristocratic name of "Boston" showed a protein content of 4.26 per cent, and a third marked "X" tested 1.45 per cent of protein. These three were practically all hulls and yet the price asked in October was from $16.00 to $18.00 per ton. The so-called Magnolia Ground Oats is a misnomer, the material being an average quality of oat offal. The article branded "Lincolnshire Fancy" is also oat offal.

It is not intended to convey the impression that oat offal is worthless as a cattle feed. It is believed that material of this character, containing from 50 to 75 per cent of hulls, in many cases ground fine to appear like meal, is decidedly expensive at the usual market prices. Certain it is that with the variety of excellent feed stuffs now on the market, decidedly more economical grain rations can be obtained for the animals of the farm than is to be found in material of this character.

Quaker dairy feed—consisting of the better grades of oat offal as a basis, fortified with some material rich in protein—averaged 13.73 per cent of protein and 3.27 per cent of fat. It carries a guaranty of 12.03 protein and 2.50 fat. It is quite even in composition from year to year.

Corn and Oat Feed, Provender.

Most of the articles sold as corn and oat feed are mixtures of oat offal, with cracked corn or hominy meal. They are frequently termed provender, but are quite distinct from true provender, which consists of a mixture of whole or crushed oats and corn. The better grades of corn and oat feed were guaranteed and known as Victor, Haskell's, Climax, De-Fi, and H-O Horse Feed. The Victor and H-O Horse Feed have been on the market for a number of years and fully meet their guarantees. The H-O Horse Feed contains some bran and linseed meal in addition to the oat offal and corn, the manufacturers apparently aiming to produce a feed similar in composition, and in feeding effect to whole oats. These two latter feeds are worthy of the attention of horse-owners, providing prices are reasonable. The feeds of the W. H. Haskell Co. evidently consist of oat offal and hominy feed. They are guaranteed to contain 12 per cent of protein, and only 9.79 per cent were found.

Chester stock feed was guaranteed to contain 11.5 per cent of protein and 4.20 per cent of fat, while only 7.37 and 2.06 respectively were found. Such a guaranty is decidedly too high for a

material of this character. Three samples of Sterling provender showed 6.76 per cent of protein which indicated a large percentage of oat hulls.

It is stated that many local millers buy inferior grades of oat offal, mix them with corn meal and cracked corn, and sell the mixture as provender. Feeders are cautioned against such adulterations. Combinations of corn and whole oats should contain 10 per cent of protein and 4 per cent of fat.

Schumacher's corn oat and barley feed was above the guaranty in both protein and fat. It has been even in composition and as represented since the inspection of feed stuffs was begun in this State.

Poultry Feeds. The different brands of poultry feed are evidently honest attempts to place on the market such grain mixtures, either ground or whole, as will be satisfactory to poultry raisers. It is believed that it is more economical for poultrymen to purchase the several grains separately than to depend upon these feeds for their supplies.

The meat and bone meals and meat scraps vary more or less in composition, depending upon the amount of bone and fat they contain. They are valuable chiefly for their protein content and should be sold on a guaranty of composition. The better class of meat and bone meal and meat scraps should contain 35 per cent and 50 per cent of protein respectively.

H. MISCELLANEOUS FEED-STUFFS.

Distillers' Dried Grains. These grains have already been defined as the residue in the process of manufacturing alcohol, spirits, and whiskey from the several cereals. They contain practically no alcohol, but are of a sour character, due to fermentation.

How classified. They may be classified as follows, depending upon the source from which they are derived.

A. Alcohol and spirits grains.
B. Bourbon whiskey grains.
C. Rye whiskey grains.

The grains produced from *alcohol and spirits distilleries* are the highest in quality, and of the most uniform grade. Corn is practically the only grain used.

The grains produced by *whiskey distilleries* vary according to the proportion of corn, rye, and malt contained in their mashes. The larger the proportion of corn, and the smaller that of rye and malt (small grain, so called), the higher the grade of dry grains produced.

Average Composition. According to information furnished by a large shipper, these grains have the following composition:

Class A. An average of 35 per cent of protein, and 11 per cent of fat.

Class B. These contain from 24 to 38 per cent of protein and from 6 to 15 per cent of fat.

Class C. Rye grains contain from 18 to 24 per cent of protein, and from 5 to 7 per cent of fat, averaging 21 per cent of protein, and 6 per cent fat.

The Yearly Product. According to the annual report of the commissioner of internal revenue (page 104), there were used in the distilleries of the United States, during the fiscal year ending June 30, 1900, 23,114,262 bushels of the different grains, corn largely predominating. At present the annual output of distillers' dried grains in this country is less than 40,000 tons, and this is mostly exported and consumed in Germany.

Value of these grains. A number of grades have been analyzed and fed at this Station. They were found to contain from 16.67 to 42.83 per cent of protein, and from 5.68 to 15.77 per cent of fat. Digestion tests showed the better class to contain 81 per cent of dry matter, 74 per cent protein, 82 per cent extract matter, and 94 per cent fat digestible.

No exact tests with dairy animals were made. The various brands were, however, fed to the Station dairy herd. The animals ate them readily, receiving 3 to 4 pounds daily mixed with wheat bran; the milk-yield was satisfactory.

Atlas Gluten Meal—also a distiller's by-product—was formerly sold in Massachusetts, and is again being offered. The manufacturers state that a guaranty of 36 per cent of protein and 11.50 per cent of fat is placed on every sack. One sample recently received at the Station showed 36.11 per cent protein, and 14.90 per cent fat, and another 33.30 per cent protein.

In 1895 the Vermont Experiment Station compared four pounds of Atlas Meal, two pounds of corn meal and two pounds of wheat bran, with eight pounds of corn meal and bran, and found that a

pound of dry matter in the form of Atlas meal in place of an equal amount of dry matter in the corn and bran mixture, increased the yield of milk and total solids an eighth, and that of the butter fat a sixth. It was regarded as the cheapest source of protein on the market at that time.

It has been stated that feeds of this character are likely to produce milk that will sour quickly, and some milk-condensing factories prohibit their use. Whether such statements are the results of careful investigation is uncertain. It would hardly be wise to feed these grains should the milk be intended especially for infant feeding, but for ordinary purposes it is believed they are not objectionable and are worthy of the attention of dairymen interested in economical sources of protein.* *They should always be bought on a guaranty.*

Brewers' Grains. There are at present some forty-two breweries in Massachusetts. The residue is practically all sold undried to farmers living in the immediate vicinity at prices varying from seven to ten cents a bushel. Assuming that 33 bushels of wet grains weigh a ton, the ton price would be about three dollars at the brewery, to which the cost of cartage should be added. Four tons of wet grains contain about the same quantity of nutritive material as one ton of dry grains, or 1.1 tons of wheat bran, or 0.8 tons of gluten feed. With this data at hand, the purchaser of wet grains can calculate at what price he can secure an equal amount of nutrition in the form of dry feed stuffs. The succulency of the wet grains is a factor not to be overlooked in estimating the value of the feed. It is not believed that the wet grain is an objectionable feed-stuff, when fed in a reasonably fresh condition and in moderate quantities.

Brewers' dried grains are fed quite extensively in many states. They have been substituted with success for oats as a horse feed, and furnish a cheap source of protein for dairymen.

Barley for Horses. Owing to the present high price of oats, it has been suggested that barley be substituted as a feed for horses. The Arabs feed their horses almost exclusively on barley. This grain is also fed to horses by the Berbers in North Africa with excellent results. Pott, a German authority on feed-stuffs, considers barley the best grain for horses, oats only excepted. In view of the extended use of this cereal as a horse feed in other countries, it is believed that it could be

*Three to four pounds daily are sufficient for each animal, fed after milking.

substituted for oats with success if economic conditions warranted. Half of the grain feed may consist of crushed or coarsely ground barley, fed together with oats, corn and oats, or corn and wheat bran. It is preferable not to feed barley exclusively until the animal becomes accustomed to it, and the feeder is in position to note its feeding effect.

Red Albumen for Poultry.

This material has been sold quite freely in New York state of late. The N. Y. Station reports some of it to consist almost exclusively of Venetian red, (oxide of iron) and sand, worth from one to two cents a pound. Another lot proved to be a nitrogenous by-product containing 72 per cent of protein—retailing at fifty or sixty cents a pound—and worth about three cents a pound.

One sample of red albumen recently sent to this Station was found to contain 45.72 per cent of protein. It was put out by a Boston druggist and consisted of nitrogenous matter resembling ground bone glue, mixed with red pepper. Good beef scrap, costing $2\frac{1}{4}$ cents a pound is preferable to such material for egg production. The composition and value of condimental stock and poultry foods have been fully explained in Bulletin 71, to which the interested reader is referred.

Sugar Beet Pulp.

Beet pulp is the residue from the sugar beet factories and consists of practically all of the beet excepting the sugar. It contains 9 per cent of dry matter, and 91 per cent of water. It has been recently offered to Massachusetts farmers at $10 a ton delivered at their railroad station. Experiments have shown it to have one-half the feeding value of corn silage. It would probably be equivalent to silage if it contained as much dry matter as the latter. Its value is about $2 per ton on the farm, and it can only be fed to advantage by farmers in the immediate vicinity of the beet factories.

I. ECONOMIC FEEDS AND RATIONS.

In view of the present high prices of concentrates, inquiries are constantly being received relative to the most economic grain rations for dairy animals. The writer feels that he cannot do better in making a general answer, than to repeat the suggestions offered a year ago.

Economical Feeds. Among the most economical concentrates high in protein may be mentioned cottonseed meal, malt sprouts, gluten products, dried distillers' and brewers' grains, flour middlings and red dog flour.

Expensive Feeds. Wheat bran contains only 13 per cent of digestible protein, and 35 to 40 per cent of indigestible matter. The long distance transportation of substances containing such a large amount of inert material, is an important factor in making the nutrients they contain relatively expensive. While it is a safe feed and most excellent for diluting or "lightening up" the more concentrated by-products, it is believed that farmers generally feed it in excess to their pecuniary disadvantage. For milkmen it often furnishes a partial cheap substitute for hay, when the latter is expensive. The above remarks apply to New England conditions, as this product is undoubtedly among the cheapest feeds for western farmers. Linseed meal while a desirable milk-producing feed, is as a rule an expensive one. It is not economical for the average farmer to *purchase* corn meal for milk production: it should be grown upon the farm. Milk producers who are obliged to purchase all of their feed can on the contrary often feed grain mixtures containing one-third corn or hominy meal to advantage. Among other very expensive concentrates may be mentioned oat feeds, and the various mixtures containing an excess of oat offal.

GRAIN MIXTURES FOR DAIRY COWS.

Mixtures to be fed with one bushel of silage* and hay, or with corn stover and hay.

1.**	2.**
100 lbs. bran.	100 lbs. bran or mixed feed.
100 lbs. flour middlings.	150 lbs. gluten feed.
150 lbs. gluten feed.	Mix and feed 9 quarts daily.
Mix and feed 7 quarts daily.	
3.**	**4.****
100 lbs. bran.	200 lbs. malt sprouts.
100 lbs. flour middlings.	100 lbs. bran.
100 lbs. gluten or cottonseed meal.	100 lbs. gluten feed.
Mix and feed 7 to 8 quarts daily.	Mix and feed 10 to 12 quarts daily.

*To reduce cost of grain, try 3½ quarts of 100 pounds cottonseed meal and 100 pounds gluten feed, *mixed with silage.*

**With silage and hay.

5.†	6.††
100 lbs.cottonseed or gluten meal.	125 lbs. gluten feed.
150 lbs. corn and cob meal.	100 lbs. corn and cob meal.
100 lbs. bran.	Mix and feed 5 to 6 quarts daily.
Mix and feed 7 to 8 quarts daily.	

J. TOPICS OF INTEREST.

The Protein Problem. The farm has been aptly called the "carbohydrate factory," the principle fodder crops produced being hay, corn fodder, corn (grain) and similar materials —all low in protein and high in carbohydrates. The problem confronting the milk producer is how to economically secure sufficient of the costly but necessary protein to supplement the home-grown carbohydrates.

SUGGESTIONS OFFERED.

By feeding the grasses and corn plant liberally with nitrogenous manure the protein content of these crops can be increased to a limited degree. This statement is based on carefully conducted experiments.

*Clover** may be grown by itself or with the grasses for hay, and as a green forage crop. It should be sown upon land rather lacking in nitrogen, and fertilized liberally with phosphoric acid, potash, and lime.

Medium green soy beans may be grown by themselves for green forage, or together with corn for silage, providing the corn and bean mixture can be successfully cut with a corn harvester, an experiment not as yet tried by the writer. It is not believed to be economical to grow them by themselves as a silage crop, for the reason that the increased cost of handling them, more than makes up for the extra protein furnished. Corn and beans have been found to make a very desirable silage mixture,‡ containing 2.5 per cent of protein against 1.7 for corn alone. Soy beans are not economical as a seed crop, it being cheaper to purchase protein in the form of cottonseed or other protein meals.

Mixtures of wheat and hairy or sand vetch, and *oats and Canada*

†With stover and hay.
††With stover and hay, preferably mixed with wet cut hay.
*Clover, beans and vetches are rich in protein.
‡About $\frac{2}{3}$ corn and $\frac{1}{3}$ beans. See Bulletin 72 for details of planting.

peas make very satisfactory soiling crops, and furnish more protein than the cereals grown by themselves.

Alfalfa has not proved successful at the Station, and reports coming from Massachusetts farmers who have tried it are not encouraging.

Corn should be grown extensively, and a silo is believed to be the most economical method of preserving it. It may be advisable to pick off some of the best ears, before putting the crop into the silo, or even to grow more than is sufficient for silage fodder. The reason for this latter suggestion is due to the fact that it is hardly wise to feed more than a bushel of silage daily for any length of time, because of its acid character. The grain* not ensiled, together with some purchased concentrate rich in protein may be fed mixed with the silage, which will take the place of bran, in so far as it acts as a diluter. By producing the fodder crops above suggested, the quantity of protein feed-stuff to be purchased may be considerably reduced.

Why only Protein and Fat are Guaranteed.

Protein is guaranteed because it is by far the most necessary and costly nutrient for the farmer to purchase. Fat is guaranteed firstly because it furnishes two and one-quarter times as much energy as carbohydrates,and secondly, because an excess interferes with digestion and normal milk secretion, and is to be avoided. The percentages of protein and fat *serve as an index* of the character of the feed. Thus an average quality of wheat bran should contain 16 per cent of protein, and if only 14 or less were found, it would indicate that the article was inferior or adulterated. Many concentrates, especially oat offal, contain an excessive amount of fiber, an ingredient less digestible than the starchy matter. A guaranty of fiber in addition to protein and fat for such feeds would furnish a better index of their character. The content of protein, fat and fiber being known†, the amount of starchy matter is easily estimated by difference. The fact must not be lost sight of however that the extract or starchy matter is a necessary and valuable animal nutrient.

*Corn furnishes a large amount of digestible matter.

†To these add 10 to 14 per cent for water and ash before substracting from 100 to get starchy matter.

HATCH EXPERIMENT STATION

—OF THE—

MASSACHUSETTS

AGRICULTURAL COLLEGE.

BULLETIN NO. 79.

GROWING CHINA ASTERS.

FEBRUARY, 1902.

The Bulletins of this Station will be sent free to all newspapers in the State and to such individuals interested in farming as may request the same.

AMHERST, MASS.:
PRESS OF CARPENTER & MOREHOUSE,
1902.

HATCH EXPERIMENT STATION

OF THE

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AMHERST, MASS.

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The co-operation and assistance of farmers, fruit-growers, horticulturists, and all interested, directly or indirectly, in agriculture, are earnestly requested. The Bulletins will be sent free to all newspapers in the State and to such individuals interested in farming as may request the same. General bulletins, fertilizer analyses, analyses of feed-stuffs, and annual reports are published. Kindly indicate in application which of these are desired. Communications may be addressed to the

HATCH EXPERIMENT STATION, Amherst, Mass.

DIVISION OF BOTANY.

RALPH E. SMITH.

GROWING CHINA ASTERS.

The remarkably widespread and general failure which has attended the growing of the China Aster in recent times led this Division to undertake an investigation of the subject, which has now extended over several years. While the results are not in all respects as complete as might be desired, the amount of material on hand and the importance of the subject to the growers of this flower seem to justify the publication at this time of what has been accomplished toward solving the problem.

It has been found that a number of troubles, quite different in their nature, are responsible for the present condition of affairs and these have been separated and identified in a fairly satisfactory manner, so that we know at present much more definitely than before with what we have to deal. The economic study of the individual diseases falls naturally into two parts, first, the nature and cause of the disease, and second, the development of means for preventing or suppressing it. Some details are still lacking in these particulars, but it is believed that enough has been learned to make the growing of the plant much less difficult than has been the case. In the course of this work all the important varieties of asters obtainable in America have been grown in quantity, and the experience of other growers in many parts of the country has been drawn upon, in order that the subject may be covered as thoroughly as possible. The conclusions presented are the result of several years' practical experience on a large scale.

THE PLANT.

The flower commonly known as the Aster or China Aster (*Callistephus hortensis*) is a native of the country from which it derives its familiar name, having been introduced into Europe about 1731.

Originally it was a single flower like the daisy or sunflower, the present double form being the result of cultivation. The original color is said to have been mauve with a yellow center. A bushy growing form with flowers of this description has been recently put on the market by European seedsmen, which is claimed to be the original species from China. The great modifications which the plant has undergone are due mostly to the German and French gardeners who were the first to cultivate it extensively and who (especially the former) grow most of the seed on the market to-day. In America the plant has been known for more than a century and is now one of the most popular garden annuals as well as an important commercial flower. A considerable amount of seed is now grown in this country, especially in California.

METHODS OF CULTIVATION.

Asters, like other annuals, are grown from seed which ordinarily is sown under glass in early spring or in the open ground later in the season. The young plants are pricked out into pots, flats, or cold frames when large enough and later set out in the open bed where they are to remain. They flourish well in almost any soil, but respond in a marked degree to an increased amount of fertility. Their best development is obtained in a moderately moist, well-drained soil, rich in organic matter and plant food.

TROUBLES IN GROWING THE ASTER.

As already stated this plant has suffered in recent years to a marked extent from a variety of troubles, which have in some cases caused its abandonment by professional growers and everywhere brought failure and disappointment to those who take delight in it. Along with those diseases which occupy more particularly the attention of the botanist, it has been found that several insects are also the cause of much damage, so that all in all no out-of-door plant is more badly affected than this.

Most of those who grow asters buy their plants from the florist when large enough to set out. They are put out in the bed and if proper care is given and all goes well it is but a few days before they are growing nicely and go on to full development. More often, however, there is trouble from the first, for it is at this stage that one of the worst diseases begins to show itself.

WILT OR STEM ROT.

This may be called the "Wilt" or "Stem Rot," and is now perhaps the most common and destructive disease of the aster. It has been known for some time but has greatly increased in abundance during the past few years, being more generally prevalent during the summer of 1901 than ever before. It is the trouble referred to by Professor Galloway in *American Gardening*, Vol. XVII, p. 518, 1896, who states that it is caused by a fungus which enters the plant near the surface of the ground and fills up the water vessels of the stem, thus causing the plant to wilt and finally die.

Symptoms. This disease is readily recognized by one familiar with it. It first appears soon after the plants are set out in the bed and is generally prevalent from that time on throughout the season, but is most noticeable at two periods, the setting of the plants and the time of blossoming. Complaints of this trouble are most abundant from the latter part of July to the middle of August, as it is during this period that most of it appears. To the casual observer the presence of this blight is first indicated by the death of affected plants. Those who examine closely find that the stem of the plant just at the surface of the ground is badly rotted and evidently the seat of the difficulty, the hard inner woody portion only remaining. This, however, is the final stage of the disease, which may be recognized much earlier. Ite effects are always seen first upon one side of the plant, usually in one of the lower leaves and almost always in one-half of the leaf. Here the normal color begins to turn to a dull yellowish green. Soon this is apparent up and down the whole length of the plant, but still on one side, a wilting, fading, "blighting" effect. At the top of the plant the leaves on the affected side are somewhat smaller than the others while further down they gradually droop and die away. The whole appearance is very characteristic, one side of the plant having the dull-green, wilted, blighted appearance with only one-half of many of the leaves affected at first. When the disease is prevalent many plants take on this appearance and die soon after being set out in the bed. Often a large lot will be a total loss before setting a blossom. In other cases plants in which the symptoms are apparent, but not so strongly marked, will throw out branches, form buds and develop a few feeble flowers before entirely perishing. Again it is very common for plants which

appear healthy up to the time of blossoming to throw out a normal crop of flowers, then suddenly show the characteristic blight, wilt and dry up in a very short time. In all these cases the disease is the same.

If affected plants in the earlier stages of the disease are pulled up and examined no indication of injury can be seen except in the wilted, dying lower leaves. The roots and stem appear perfectly sound and healthy. It ls only on cutting open the stem, just at the surface of the ground, that the seat of the trouble is found. Here will be found a dark discoloration in the outer edge of the harder, woody portion of the stem, where it joins the soft "bark" or cortex portion which covers it. At first this is only a small spot on the affected side, but may always be found when the exterior symptoms

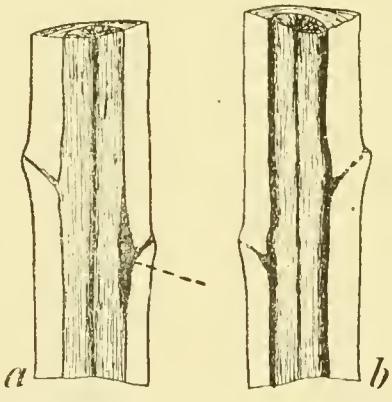

Fig. 1. Longitudinal sections of Aster stems attacked by Stem Rot: showing discoloration. *a* early stage. *b* considerably affected.

have begun to appear. This discoloration spreads around and up the stem, always in the woody portion at first, but finally the soft outer part is affected and rots away, leaving the wood intact, though it was the first portion to be attacked. By this time the plant is dead so that if first examined at this stage the stem is found in the condition described.

The cause of this trouble may readily be found with the microscope. This is seen to the best advantage in a plant in the earlier stages of the disease where the outer green cortex of the stem is still sound and intact. By examining a thin section of the discolored woody portion it will be seen that the discoloration is confined mostly to the large vessels or pores through which the water passes up from the roots. These are still intact and uninjured, but in the

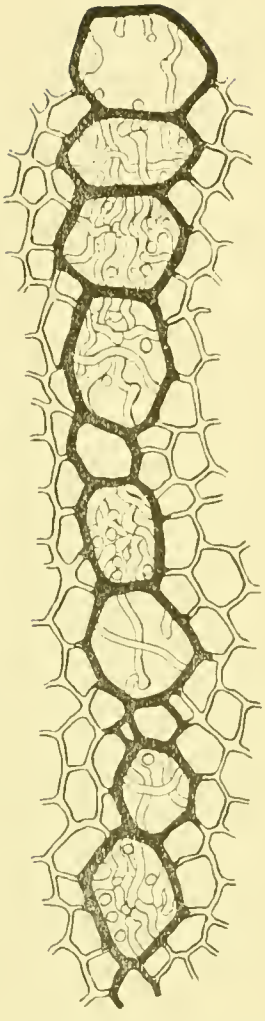

Fig. 2. Cross section of affected tissue, much enlarged, showing vessels plugged with fungus and discolored.

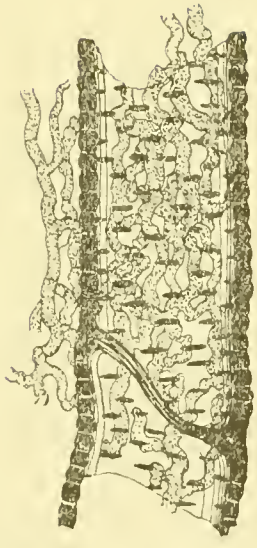

Fig. 3. Duct from stem, much enlarged, with fungus.

interior of most of those which are already affected as shown by the darker color, there will be seen a mass of fungus growth which completely plugs up the opening and evidently prevents the free passage of water or sap through the vessel. All stages leading up to this final result will be seen. In the more newly affected vessels only a few filaments of the fungus are present, but these soon increase, fill up the passage and spread into new tissue until all the larger water vessels are plugged up. Thus is explained the gradual wilting of the plant, beginning on one side, as more and more of the water from the roots is cut off until finally the whole plant dries up, simply from lack of water and soil-food, and not directly on account of the effects

of the fungus. In the final stages of the disease the outer portion of the stem becomes affected and rots away.

All this may readily be seen with the microscope. The important question now arises, where does this fungus come from and how does it attack the plant? The solution of this point underlies the whole problem of preventing or treating the disease. A particular case may be described. In the spring of 1900 we planted a large amount of aster seed in flats in a greenhouse. The seed was planted quite thickly so that the plants after coming up stood very close together in the rows. A long period of wet cloudy weather followed and soon the trouble known as "damping off" set in quite abundantly. The affected seedlings did not die suddenly, but would wilt down and gradually wither away. Examination showed that the base of the stem and roots had rotted off. As soon as possible the plants were pricked out, saving only the best. Many more rotted off after this, so that when the permanent beds were set out on June 8 many varieties were very poorly represented. It was noticeable in the flats that many plants showed a trouble, evidently a continuation of the damping off in the seed bed, which resembled in every way the wilt of older plants just described, except that being younger and more tender the stem rotted off more quickly. This rotting affected first the woody tissue as in the typical disease. Plants in the flats were continually wilting and dying in this way. In many cases, however, an apparent recovery took place. In some lots of badly affected seedlings almost every plant showed at the time of pricking out a small dark spot on the stem, from which the rotting proceeded. In those which appeared to recover a callous tissue grew over this spot, becoming a sort of scab and appearing to check the decay of the stem. By carefully following individual plants it was found that these were the plants which showed the wilt disease after being set out. The fungus in all these cases was the same. This is an important point, namely, that *the disease was contracted in the seed bed as a result of conditions which favor damping off.*

Acting upon this idea comparisons were constantly made between plants started in the greenhouse which damped off more or less and those which were started in the open ground and kept in vigorous growth from the first. The development of individual plants and typical lots of plants, affected and unaffected, was carefully followed up, with the result that in every case where plants died from stem

rot after being set out in the bed, even though in many instances no trouble showed itself until the time of blossoming, *the disease came from the seed bed and was not contracted by healthy plants after being set out in the field.* Our own plants have been started each year in the same house, the same flats, and possibly to some extent in the same soil. It seems almost certain that the germs of this fungus are thoroughly established here; at any rate the trouble has steadily increased from none in 1899 to almost every plant in 1901, while each year plants started out of doors, set out in the same beds and often in ground occupied by diseased plants the previous year have shown no trouble of this sort whatever. The past season when the greenhouse-started plants were almost all killed sooner or later by the stem rot, our large bed presented a most instructive appearance. At one end was a large block of plants started out of doors. Here and there through the bed were a few other rows of similar plants. The rest of the field had been set with greenhouse plants. By the time that blossoming was well under way scarcely a plant remained alive in the whole bed except in the portions set with out-of-door plants, and here not a single plant showed this blight.

Treatment for Stem Rot. Plainly the avoidance of this disease lies in starting with healthy plants, grown out of doors or in cold frames, rather than in the greenhouse where the conditions are more favorable to damping off. Of course many good plants are started in greenhouses, but the disease is rapidly increasing in prevalence and appears to start almost invariably from such conditions. Plants started out of doors are insured against this trouble, and, though perhaps a little later, may easily be brought to full development at the normal season. As regards time of blossoming there is no marked advantage in obtaining very early plants, with the possible exception of Queen of the Market and similar extra early varieties. Plant the seed in good soil out of doors as early as the ground can be thoroughly worked, in a place where asters have never grown before. Thin out the young plants if necessary, transplant to the permanent bed as soon as they are large enough and when conditions are favorable, and, so far as stem rot is concerned, no trouble need be feared. The knowledge that the disease is contracted only in the seed bed is, of course, the basis of this recommendation, which though brief and simple, is believed to be one of the most valuable points brought out in this bulletin.

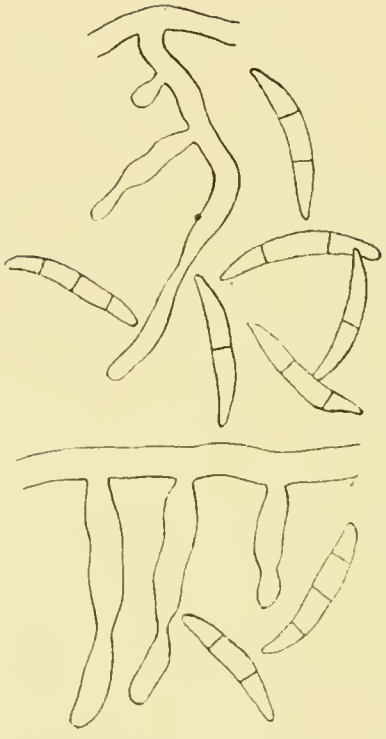

Fig 4. Conidial spore formation in stem rot *Fusarium*.

This disease is entirely similar in its general aspects to those described by Erwin F. Smith on Melons, Cowpeas, etc., by Masse on Tomato, and others of the same class, caused by forms of *Fusarium*. The present species or form appears, so far as studied, to have very little tendency toward spore formation. Young affected plants placed in a moist chamber soon become overrun with a white mycelium upon the shorter branches of which lunulate *Fusarium* conidia develop in abundance. The production of such conidia or of any other spore form, has never been observed upon affected plants in any stage of the disease, though carefully looked for in a large amount of material. Cultures on potato and prune juice from affected tissue give mostly white sterile mycelium with occasionally a few conidia. A similar growth is also produced in a great many cases from affected plants in the moist chamber. Infection takes place readily in seedlings started in earth in which affected tissue has been buried. At the same time it is to be noted that in our thoroughly infested house, plants started in sterilized earth were quite as badly affected as those in ordinary soil. and by the same *Fusarium* fungus. Apparently, therefore, conidial infection of seedlings occurs. Further experiments are now going on in regard to the mode of infection, but a long series of observations has left no doubt that the disease is contracted in the seed bed and that plants which are healthy when set out in the permanent bed are thereafter immune, even in infected soil.

Fig. 5. Aster plant with Yellow Disease. Flowers all blighted.

Fig. 6. Aster plant very badly affected with Yellow Disease.

Fig. 8. Normal development of Aster blossom.

Fig. 9. Asters affected on one side by Yellow Disease.

TROUBLES SIMILAR TO THE WILT OR STEM ROT.

There are two other troubles, both caused by insects, which may sometimes be mistaken for the disease just described. One of these is produced by the common "White Grub" (*Lachnosterna*), the immature form of the May beetle or June Bug, which, by eating off the roots, causes the plant to wilt and die. Here the whole plant wilts at once and by pulling it up the nature of the trouble is at once discovered. If not too late the guilty party will be found by digging up the earth at the base of the plant, or if not there, is usually to be found at the next plant in the row. By close watching they may be readily detected and destroyed before much damage is done. Sometimes a plant, if not too badly affected, may be set back again and recover. This pest is much worse in dry soil and varies in abundance from year to year.

Root Lice. This is another cause of wilting and stunted growth and is, in many respects, the worst trouble affecting the aster. Affected plants fail to grow properly and have a wilted, unhealthy, and generally stunted appearance. They do not die quickly, but often remain in the bed all summer without increasing in size to any apparent extent. When pulled up, the roots, or what remains of them, are found to be covered with masses of a bluish-colored louse in all stages of development. Certain of our own beds are so infested with this insect that asters can no longer be grown in them. It is the most troublesome pest with which we have had to contend. Its life history does not appear to be known by entomologists and one can only recommend the use of new, uninfested soil as a preventive measure. This applies to the seed bed, permanent bed, and all situations in which the plant is grown.

YELLOW DISEASE OR BLIGHT.

Under this heading may now be taken up one of the most peculiarly obscure diseases with which any plant is affected. Caused by no fungus, insect, or other organism, not due to any apparent effect of treatment or environment, it is notwithstanding a sharply defined, widespread and destructive disease of this plant. Its general effect is a bright yellow "spindling" growth. Affected parts do not die or wilt, but show simply the peculiar growth which prevents their

proper development. This trouble begins to appear after the plants have become well established in the permanent bed. Affected specimens show at the summit or growing tip a light greenish-yellow color instead of the normal dark green. Leaves previously formed do not change their color, but from the point where the trouble began the succeeding stem and leaves have the yellow color. There is no dying or any such effect, simply the "spindling" yellow growth. The effect is curious and unmistakable. At the same time similar yellow shoots begin to appear from the axils of the leaves on the main stem. In the worst cases growth is checked at this point and the plant remains through the summer as shown in fig. 6, a stunted stem, yellow at the top, with numerous short, unhealthy-looking yellow branches along the sides. From this the intensity of the trouble varies to the other extreme where only in a few of the last flowers of the season is the abnormal color and growth apparent. Microscopic examination of the affected stem and leaves shows nothing abnormal except a lack of green coloring matter. The roots even of the most diseased specimens are abundant, sound, and healthy-looking (see fig. 6). Absolutely nothing has been found in any part of the plant to account for the effect. After the disease once appears it keeps cropping out here and there all through the season, the latest plants to show it being the least affected. The most striking effect of this peculiar malady is seen in the flower. The *flower*, so-called, of the aster, is, it should be remembered, in reality a large number of very small flowers crowded together upon a disk-like base or receptacle. Two forms of these small flowers or *florets* occur, those about the edge, the *ray florets*, each of which bears a single petal, and those in the center, the *disc florets*. This is seen most plainly in the single aster, where the disc florets form the yellow center or "eye" of the flower. The double-flowered forms, which are considered most desirable, are the result of the transformation of the disc florets into ray florets, so that each bears a petal. The more complete this transformation the more double the flower. A perfectly double aster is not common except in certain varieties, for the center usually remains in its normal form. The disc florets bear both stamens and pistils and so always produce seed. The ray florets bear only pistils: consequently they produce no seed unless fertilized with pollen from the disc florets. For this reason the well-known fact comes about that the more double the

Fig. 7. Normal Aster florets. *r* ray, *d* disc.

flower the less seed it produces. A perfectly double flower produces no seed unless pollen is brought to it by insects from other more single flowers.

Fig. 10. Normal and affected pistils showing enlargement by Yellow Disease. *n* normal, *d* diseased.

Fig. 12. Longitudinal sections of young florets showing normal (*b*) and affected (*a*) ovules and pistils.

The normal development of an aster blossom is seen in fig. 8. At the end of each shoot there first appears a cluster of small, leafy bracts, from the center of which the flower bud gradually develops and opens. In plants badly affected with the yellow disease no flowers develop upon the yellow sickly-looking shoots, or only rudiments of them. In numerous cases, however, blossoms appear upon normal branches, which are peculiarly affected by the disease. Some show it in the whole flower, others only upon one side or in a small portion. The first noticeable peculiarity is in the color, which is of the same greenish yellow as that of affected leaves, without regard to the natural color of the variety. Where the whole flower-head is affected it has a peculiar unnatural appearance, while often one side is perfectly normal while the other is yellow and diseased. (Fig. 9.) Closer examination of affected florets shows a remarkable and characteristic change. This is the greatly increased size and length of the *pistil*, which occupies the center of each floret. Fig. 10 shows a normal and a diseased floret, all the parts being removed except the pistil. These are drawn to the same scale. The ovary or seed-bearing part at the base is much longer and

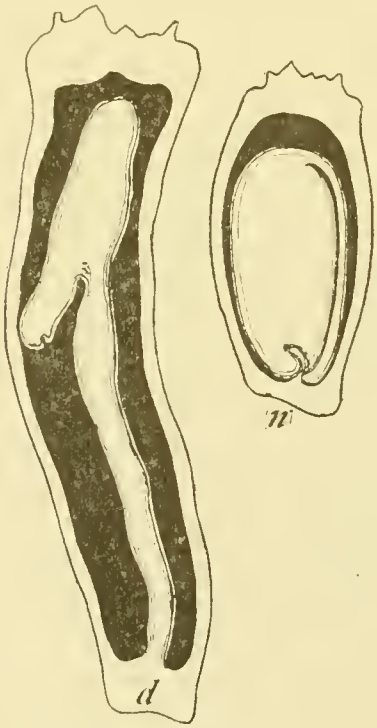

Fig. 13. Later stage of Fig. 12. *d* diseased, *n* normal.

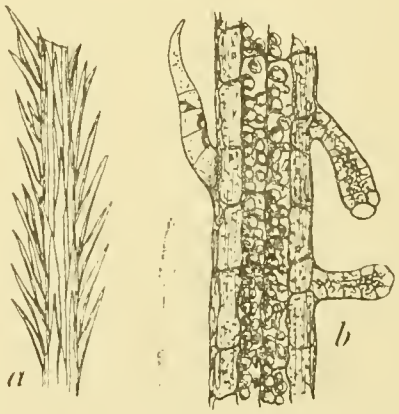

Fig. 15. Portions of pappus hairs. *a* normal; *b* modified form found in Yellow Disease.

thicker, and the same is true of the portion above. Splitting the ovary lengthwise the same change is found to have taken place in the *ovule*, or rudimentary seed, which has grown up on a long stalk (see figs. 12 and 13). A further peculiarity is shown in fig. 14. This is the sharp turn upward which the affected pistils take, just as the stem of a plant takes when bent over. Further changes are found in the *pappus*, the circle of capillary hairs at the top of the ovary. These normally consist of fine stiff bristles, having the structure shown in fig. 15, a. In diseased florets the pappus is mostly undeveloped and its place taken by a fringe of small lobes, having a cellular structure and containing chlorophyll, forming something of a true calyx, which the pappus represents (fig. 15, b.).

The changes in the plant under the influence of this disease may be summarized something as follows:

Root: Apparently well developed and entirely normal, even in worst cases.

Stem and Branches: No structural change. Pale yellow color, poor in chlorophyll, often slender and spindling. In worst cases stunted and very short.

Leaf: No structural change. Color yellowish and sickly. Poor in chlorophyll. Often poorly developed in size and form.

Flower: Bracts, no change.

Calyx (Pappus), apparent tendency to revert to leaf-like lobes or sepals. All stages of transition occur between the proper branching hairs and chlorophyll-containing lobes or bract-like scales.

Corolla, *color*—changed to uniform light greenish-yellow without regard to original shade. *Form*—in ligulate ray florets slender and closely incurved, appearing tubular. In disc florets elongated, retaining tubular form with short lobes at extremity.

Stamens, general tendency to abort. Anthers small and shrivelled, producing little or no pollen, not cohering in a ring about the pistil.

Pistil—general tendency to elongate. *Stigma* much elongated and enlarged, protruding abnormally from the corolla tube. *Ovary* much elongated and somewhat enlarged. Few hairs on outside. *Ovule* elongated, shrivelled and apparently not fertilized. Funiculus especially grows very long, keeping pace with the ovary.

Beside these changes it may be mentioned that plants which are at all affected bear little or no seed, even in the normal flowers.

Consideration of these changes, together with the general study and observation of the disease, leads to the conclusion that they (the changes in the flower particularly) are not the direct effect of the cause of the trouble, whatever it may be, but are simply secondary symptoms of a certain weakness. They all indicate plainly a *reversion* from the reproductive to the vegetative function. The elongation of the pistil, the abortion of the stamens, the transformation of the pappus hairs into green lobes, the strong response of the affected florets to the effect of gravity, and the non-production of seed, all go to show, not that the flower is diseased, but that from some cause the plant lacks the vitality or form of vitality necessary for the reproductive function. A strikingly suggestive similar case helps out this idea. Marguerite plants in our college greenhouses have recently shown a disease very closely resembling this of the aster. The same yellow shoots appear and the same effects in the flower (fig. 17). Here, however, it occasionally occurs that a form such as is shown in fig. 18 develops. Here each pistil has elongated into a stem, bearing another flower bud, so that the single blossom would become, if all expanded, an umbel-like cluster of flowers. These secondary buds, however, have never been known to open into flowers. Here, then, the change from the reproductive to the vegetative is still more plainly brought out. Besides in the Marguerite, it may be mentioned that similar diseases to that of the aster have been observed in the Calendula and African Marigold, each producing the yellow spindling shoots and abortive flowers. Plants of the ragweed or Roman wormwood (*Artemisia*) are also often seen in this vicinity which show a yellow color and quite similar appearance.

CAUSE OF THE YELLOW BLIGHT.

A number of different causes have been assigned to this disease by aster growers. First may be mentioned the case described by Dr. W. C. Sturgis of the Connecticut Experiment Station, who ascribes what appears to be this same disease to the effects of Nematode worms on the roots. Nothing is said about the peculiar effect in the flower, but the spindling yellow growth is mentioned. While it is not improbable that the root-gall nematode might attack this plant

Nematode Worms.

as found by Dr. Sturgis, the writer has never seen such a case and can state positively that no such organism is the cause of the disease now under consideration. The roots of all the affected plants examined have been perfectly clean and healthy.

Root Lice. The presence of lice in the roots has been thought by some to bring about the disease, but only a very brief examination is needed to show the incorrectness of this idea. Where this pest is abundant numbers of plants may be found whose roots are covered with lice but which still show no sign of the yellow disease. It is indeed quite evident, on close examination, that these pests are much more abundant upon normal than upon diseased plants in the same bed.

Fungi, Bacteria, or other Organisms. It is natural in a plant disease to look for some parasitic organism as the cause. In many respects the appearance and nature of this disease lead one to suspect some such origin, but it may be said at once that the most careful search in all parts of the plant has failed to reveal anything of the sort. That the trouble is purely of a physiological nature, due to some perversion of the normal functions of the plant can scarcely be doubted.

Varieties. The trouble is equally prevalent upon all varieties of asters. Besides the large amount of evidence on this point obtained incidentally in the course of this work from our own plants and those of many other growers, this matter was especially tested in the summer of 1900. Seed was obtained of all the varieties of any importance obtainable in the country, over three hundred separate lots in all, and the plants of each kind set out in one long bed for comparison. The result was that while naturally some variation in the amount of disease occurred, no important difference could be seen in favor of or against any variety. It is interesting to note that the alleged "original" aster obtained of Heinemann, of Erfurt, Germany, was one of the worst affected varieties.

Source of Seed. In purchasing seed care was taken to inquire in each case where it was grown. In this way a comparison was instituted between plants from seed grown in Germany, France, England, California, New York, and Massachusetts. No difference whatever appeared.

Old Seed. Seed more than one year old germinates poorly, but the plants are not any more nor less liable to the disease.

Storage of Seed. It has been suggested that the temperature at which the seed is kept over winter might influence the vitality of the plants. To test this, home-grown seed was kept over winter in the following situations: lot 1, at an ordinary living temperature, lot 2, in a cool attic, and lot 3 in a shed at practically out-of-door temperature. Along with these lots was also planted some seed gathered on March 19 from old plants which had stood out all winter. No difference appeared in the resulting plants. All were more or less diseased.

Effects of Transplanting. The idea is sometimes expressed that transplanting is instrumental in bringing on this disease and that plants grown direct from seed without being disturbed do not show it. The last point has been clearly disproven in numerous instances by the appearance of the yellow blight in beds of asters which had never been transplanted or disturbed. To test the matter more definitely three beds were prepared in the fall of 1899 by digging up turf land and working in, a liberal dressing of barnyard manure. No. 1 was

Fall Planting. planted on Nov. 3d with aster seed in hills 9 in. apart, 8 or 10 seeds in a hill. On April 21 of the following year the young plants began to appear and all the hills came up well. Bed No. 2 was planted in a similar manner on April 28. Germination was prompt and good. Bed No. 3 was set out with plants in the ordinary manner early in July. As the plants in 1 and 2 grew larger they were gradually thinned until one remained in each hill. In rapidity of growth and general appearance of vigor bed No. 1, planted the previous fall, showed the best lot of plants which we have ever grown. They were of the Semple variety and grew up tall, stout and bushy. Bed No. 2 was quite as good, but somewhat later. Despite this vigorous growth, the yellow disease in beds No. 1 and 2 was much the worst on the place. Nearly 50 per cent of all the plants became badly affected. Bed No. 3 was nearly as bad. Plainly, therefore, this method cannot be recommended for preventing the disease. Still it is not believed that this style of planting would in general tend to increase the amount of yellow blight, and the extreme vigor of the plants in other

Fig. 11. Sections of normal and yellow diseased blossoms, showing abnormally long ovaries. Upper two normal.

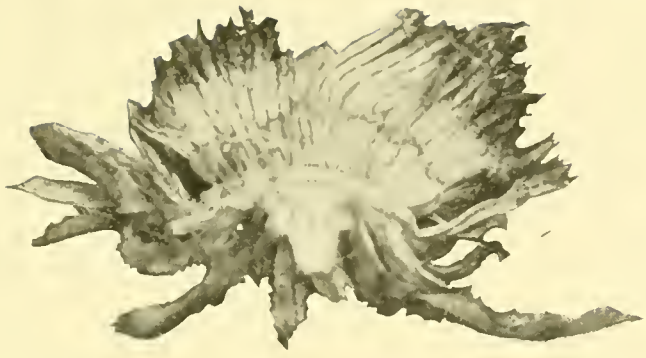

Fig. 14. Section of partially diseased blossom, showing upward turn by affected florets.

Fig. 16. Branch of Marguerite plant affected by Yellow Disease similar to that of Aster.

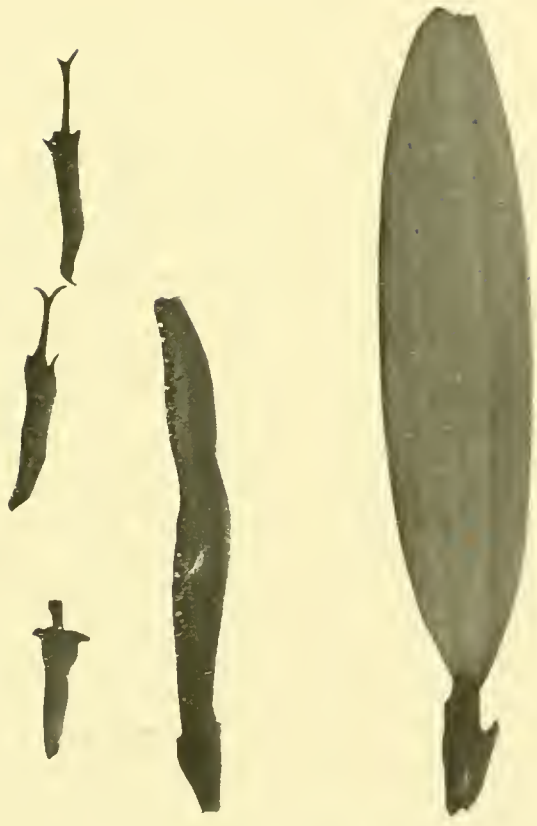

Fig. 17. Normal and affected ray and disc florets of Marguerite, showing elongation of pistil

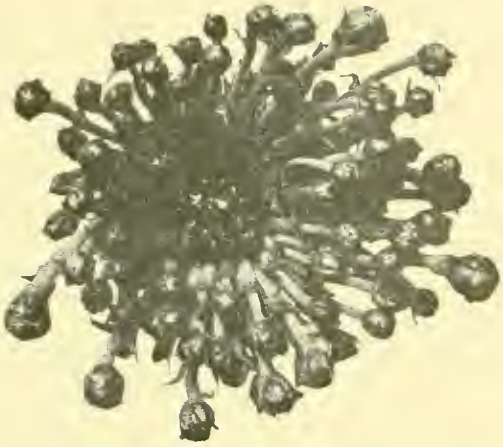

Fig. 18. Affected Marguerite blossom transformed into umbel of flower stalks.

Fig. 19. Single modified florets from Fig. 18.

respects makes fall planting worthy of trial. Freedom from stem rot is especially marked, but root-lice infested soil must be carefully avoided.

Number of Times Transplanted. Comparison between plants transplanted once, twice and more times showed no difference in the amount of the disease.

Heredity. The theory is most plausible that a trouble of this nature would be brought about or transmitted by the use of seed from affected plants, and it was confidently believed that experiments along this line would show definite results. In the fall of 1899 seed was carefully selected from plants affected in all degrees with the disease. Such seed was found difficult to secure, for, as previously stated, affected plants produce very little. A good series, however, was finally obtained and that from each plant carefully labelled with its history and saved by itself. This seed was planted the following spring, germinated well, and the seedlings were pricked out and then transplanted into the open ground. Contrary to expectations these plants were as fine a lot as any and showed less of the yellow disease than the average. In one row of 13 plants, seed taken from a plant in which all but one small branch was badly diseased, none were affected. Another row of 12 from a plant considerably affected, had none affected. These were two as nice rows of plants as any in the field. Other rows of 18, 20 and 25 plants had from 1 to 3 diseased, the others excellent plants. Altogether 138 plants matured in these lots, and 5 were diseased. Comparing this with the result in the bed planted in the fall with the very best home-grown, selected seed, all from perfectly healthy plants, where nearly 50 per cent were badly affected, the overthrow of the heredity idea is complete.

Physical Properties of the Soil. The growth of asters upon various types of soils, wet and dry, heavy and light, clay, loam, sand, gravel, etc. has been tested quite extensively on our own grounds and by giving plants to others in various places, as well as by general observations. Without going into detailed descriptions it may be said that no difference in the amount of yellow blight could be laid to this source.

New vs. Old Soil.

Some growers of experience in growing asters have claimed that this disease steadily increases from year to year if asters be planted on the same ground, there being very little the first year. This is not borne out by our experience or observations in regard to this disease, though true in the case of some other troubles. Repeated instances have occurred of severe outbreaks of the disease on new land where asters had never been before, while on the other hand numerous examples can be cited where on ground badly affected one year very little of the disease appeared the next. Certainly no general rule holds good in this respect.

Chemical Nature of the Soil.

The question of the chemical constituents and fertility of the soil is naturally one of great importance in this connection. On considering, however, the variety of soils upon which the disease occurs and its general distribution, there is little basis for supposing the disease to be due to the presence or lack of any particular substance or substances. Quite extensive experiments have nevertheless been made along this line, but with no result. As between mere fertility and its absence no difference appears except in the general size and development of the plants. The disease is equally prevalent. In regard to particular elements of plant-food plots were laid out in two successive seasons and various combinations of the essential elements tested, together with the effect of lime, comparisons between barnyard manure and fertilizers, etc. etc. No important differences appeared. Plots with no fertilizer, with lime, barnyard manure, and all the combinations tested showed the disease practically alike. While more exact tests might have been made, the entire absence of suggestive results showed plainly enough the futility ot further work along this line. Application of fertilizer at intervals through the season was also tested, but with no effect.

NOTE.—In the principal experiment on fertilizers nine plots 6x25 feet were laid out, separated by 3 ft. paths, on a level, uniform piece of land of good general fertility, where asters had been the previous year. To these plots were applied: No. 1, nothing; No. 2, 1½ lbs. Sodium Nitrate, 1½ lbs. Muriate of Potash, 1½ lbs. Dissolved Bone-black, No. 3, 3 lbs. Sodium Nitrate, applied at intervals throughout the season; No. 4, 3 lbs. Muriate of Potash, applied at intervals; No. 5, 1 lb. Sodium Nitrate, 1 lb. Muriate Potash, 1 lb. Dissolved Bone-black: No. 6, same as No. 2 but applied at intervals: No. 7, same as No. 5 but applied at intervals: No. 8, same as

No. 5; No. 9, 3 lbs. Dissolved Bone-black, applied at intervals. Half of each bed was set with Semple Asters and half with Queen of the Market. On other beds a liberal dressing of lime was given, in addition to stable manure, on still others wood ashes, complete fertilizers and manure alone, etc., etc.

Weather Conditions. Observation and inquiry show beyond doubt that the prevalence of this disease varies in different seasons, though in a broad and general way, the conditions prevailing in one year are apparently more conducive to it than those in another. Thus in 1899 this trouble was much more common than in 1901, even on land planted each year in asters.

Plants in Pots, Benches, Etc. For various purposes during the course of these investigations, plants have been grown in large pots, elevated boxes of earth, greenhouse benches, and similar situations. It was early noticed that the yellow disease seemed very much less abundant in such plants than in others of the same lots growing near them in the soil. Inquiry among gardeners revealed the fact that others had noticed the same peculiarity. Asters for the early market are not infrequently grown in greenhouses, and so far as our observation goes, the disease is practically unknown under such conditions, though plenty enough in the open ground near by. Without doubt there is in this respect a marked difference in the prevalence of the disease. We have grown many plants in large box trucks, and in these the only trace of the yellow blight that has ever appeared has been a very little in a few of the last flowers of the season. The chemical and physical properties of the earth in these trucks and in many pot experiments have varied widely, but these features have shown no relation to the disease. It is difficult to see how the simple change from the open earth to a pot or box can produce such marked effect, but certainly it is exerted by some obscure influence.

FURTHER CONSIDERATIONS.

All the study and observation of this disease go to show that it is due to an obscure perversion or derangement of the vital functions of the plant. That the trouble is so generally prevalent on all kinds and conditions of soil and is unaffected in its occurrence by any of the widely varying influences enumerated above, seems sufficient to

show that the abnormal condition which causes the trouble does not lie in exterior circumstances but rather must be sought in the plant itself. In other words individual cases of the disease are not caused by any improper or unhealthy conditions, but are the result of an inherent, constitutional weakness or misadjustment in the plant which may manifest itself under any or all conditions. The results thus far obtained in this direction appear to indicate that it is in the nutritive functions that the trouble exists. In a plant like the aster nutrition is obtained from two sources: water and mineral salts from the soil, and carbonic acid gas from the air. Both of these go first to the leaves where assimilation takes place, the *water* and *carbonic acid* being combined into *starch*. As this process goes on only under the influence of sunlight the formation of starch in leaves begins each morning at sunrise, goes on through the day, and ceases at nightfall. During the night the starch thus formed is converted into *sugar* by the action of *diastase*, a substance present in the leaves for this purpose as in the saliva and pancreatic juice of animals. A normal, active leaf, therefore, is full of starch each evening, but contains next morning scarcely a trace of this substance. Besides diastase leaves contain other substances or *enzymes* of a similar nature, which bring about various changes in the nutrient substances.

It appears to be in this process of starch conversion or metabolism that the aster trouble is located. If normal leaves are taken late in the day and tested by the customary method of extracting the green color with hot water and alcohol and then soaked in iodine, a deep blue-black color is produced, showing the presence of a large amount of starch. Leaves picked in the morning show none of this substance, all having turned into sugar over night. When leaves affected with the yellow disease are tested in the same way it is invariably found that night or morning, *they are at all times full of starch*. This shows, therefore, a lack of the diastactic action which should turn the starch into sugar and render it available as food for the plant. It is further found that in leaves which have only partially lost their green color under the influence of the disease the diseased (light-colored) areas show at all times less starch than the green portions. It is to be expected that less would be produced here, but apparently diastatic action is no more active in the green than in the yellow portion of such leaves.

For further study in this direction equal weights of badly diseased and normal leaves were gathered and ground in a mortar to pulp. The addition of a considerable amount of fine quartz sand greatly facilitates the grinding. Equal amounts of distilled water were then added to each portion and the decoctions allowed to stand over night, first adding a few drops of chloroform to prevent the growth of molds or bacteria. The solutions thus obtained show several constant differences. That from diseased tissue is decidedly acid, while the normal is neutral or very nearly so. This difference becomes very marked on standing a short time. The diseased has also a sour, unpleasant odor, quite different from that of the other. When tested by the Guaiac method the diseased always shows much less *oxidase* and *peroxidase* reaction than the normal. With ferric chloride the diseased shows much more *tannin* than the other. Equal quantities of the two solutions were added to equal amounts of a saturated solution of corn starch in water, showing with iodine a deep blue-black color. After standing fifteen hours the normal leaf solution gave no more blue color, showing *diastase* had been present in the tissue sufficient to convert the starch into sugar. In the diseased solution a strong starch reaction still took place, re-affirming the results obtained by treating entire leaves that diastatic action is very weak in affected leaves. The same result was also obtained by adding to the starch solution a powder made by drying the leaves and grinding them as finely as possible.

In the same way solutions were made and tested, using diseased and normal flower heads and buds, with no green parts included. These decoctions showed *much more* oxidase and peroxidase in the *diseased* than in the normal; the reverse of the results with leaves.

To sum up, these results indicate that in plants affected by the yellow disease the leaves have the power of assimilation or starch formation, but are deficient in diastatic and oxidizing action and contain an abnormal amount of tannin and acids. In parts not normally green and therefore having no assimilative function, oxidation is more than normally active. The latter symptom is of ordinary occurrence as a *starvation* phenomenon, and may therefore be attributed to the lack of nutrition brought about by the failure of diastatic, and perhaps other forms, of metabolic action in the leaves. In the leaf itself the results are not sufficiently complete for drawing broad or general conclusions. The presence of abnormally large

amounts of acids and tannin indicates a non-performance of some of the complicated processes of metabolism, which should carry off these injurious by-products. The failure of the diastatic and oxidizing functions are symptoms of a similar nature.

It therefore appears, so far as conclusions can be drawn, that this "yellow" disease of the aster is due to a failure of those metabolic activities in the leaf which when properly carried on furnish nutrition for the plant. Further, it is believed that the characteristic effects in the flower, which have been shown to be a change or reversion from reproductive to vegetative development, are simply a secondary symptom and the result of partial starvation in those parts. The actual, fundamental *cause* of all this is still unexplained, except that, as stated, it is not due to individual circumstances, but is the result of a misadjustment of the plant to what should be its normal environment. The fact has been mentioned that there is a well-defined variation in the amount of the disease in different seasons. It seems not improbable that such circumstances as the frequency of rainfall, relations of rainfall to sunshine, and such conditions as would strongly and suddenly affect the functions of the plant may be concerned in the result.

Finally it may be mentioned that this disease is one of an increasing list of somewhat similar troubles. Most prominent of these is the peach "Yellows." The "Calico" disease of the tobacco is another, in connection with which the researches of A. F. Woods of the U. S. Department of Agriculture have given many suggestions in the present work.

THE ASTER RUST.

A true rust affects the aster very commonly. This is seen in orange-colored pustules which break out on the under side of the leaves rather late in the season. While prevalent everywhere the disease is not at all destructive and does no apparent damage to the plant.

THE BLACK BEETLE.

One of the best known aster pests is the slender, lively black beetle (*Epicauta Pennsylvanica*) which attacks the blossoms. If left unchecked they soon destroy every flower when at all prevalent. Thorough hand picking has been our best remedy and if done every day is no great task even in a large bed.

GRASSHOPPERS.

In aster beds located near fields of grass the outer rows are often completely eaten up by grasshoppers. This may be prevented by planting something else on that side next the grass.

VARIETIES OF ASTERS.

Since all the varieties of this plant obtainable have been grown in connection with this work a few words about the various kinds may not be out of place. Asters are commonly distinguished into *types* or groups, similar in form and general characteristics, under each of which we have a variety of colors. They may also be classed into early, mid-season, and late, coming into bloom ordinarily about July 20, August 15, and September 1, but varying, of course, with the time of planting. The Queen of the Market, in various colors, is the standard early variety, together with the similar Queen of Spring, Queen of the Earlies, etc. The recently introduced Tom Thumb Comet or Poodle, is also worthy. Of the mid-season the Victoria, Paeony Flowered Perfection and Giant Comet are best known, but by no means include all the best kinds. The new California Branching Comet is especially striking, and many others might be mentioned. Of the late varieties Semple's Branching stands pre-eminent as one of the finest of asters, especially for commercial purposes. The pink "Mary J. Semple" is considered by many the finest of all asters. It is with difficulty that such a list as this is brought to an end, on account of the many beautiful kinds left unmentioned. The dwarf varieties are numerous and odd but of no great value for cutting.

SUMMARY.

The very prevalent trouble in growing China Asters is due to a variety of causes. These are principally, a stem rot disease or wilt, caused by a fungus, a peculiar abnormal growth the cause of which is not definitely known, and lice on the roots. Other troubles occur but are more obvious or not generally destructive.

The stem rot disease is characterized by a wilting and final dying of affected plants, accompanied by a discoloration and rotting of the stem just at the surface of the ground.

The yellow disease appears as a spindling yellow growth of the

branches and leaves and a peculiar abnormal development of the flowers. It seems to be due to a failure in the metabolism in the leaves.

Plants affected with root lice fail to grow and finally wilt and die. The roots are found to be covered with masses of small, bluish-colored plant lice.

The stem rot or wilt, although first showing itself at any time during the plant's growth, appears to be contracted only in the seed bed or pricking out flats. Both this disease and tne root lice may be avoided by proper methods of cultivation. For the yellow disease no treatment is known. None of these troubles can be remedied after they have once appeared.

Asters are also affected by a true rust of the leaves, grubs which eat the roots, and insects which eat the leaves and flowers.

DIRECTIONS FOR GROWING ASTERS.

Start your own plants. Seed planted as late as June 1st will give an abundance of bloom before frost.

Procure seed directly from a reliable seedsman. It costs no more and is much more liable to be fresh and true to name.

Sow the seed in the open ground at any time after the ground gets into good condition, in good soil where asters have never grown before. Fall sowing out of doors may also be practiced. For very early flowering sow in cold frames or in the greenhouse, but this, especially the latter, is much more liable to produce stem rot.

Avoid at all times the use of soil where asters have grown before, especially where the stem rot or root lice have occurred.

Prepare the permanent bed by working in a liberal dressing of barnyard manure during the previous fall and a light application of any good commercial fertilizer in the spring. If this is not practicable remember that as a general principle the richer the soil the better will be your asters.

Plant if possible in moderately moist soil. This will give better growth and less trouble from grub worms.

Beyond this it is believed that no treatment can avail for these troubles. *Avoid especially damping off and root lice.*

HATCH EXPERIMENT STATION

—OF THE—

MASSACHUSETTS

AGRICULTURAL COLLEGE.

BULLETIN NO. 80.

FUNGICIDES,
INSECTICIDES,
SPRAYING CALENDAR.

MARCH, 1902.

The Bulletins of this Station will be sent free to all newspapers in the State and to such individuals interested in farming as may request the same.

AMHERST, MASS.:
PRESS OF CARPENTER & MOREHOUSE,
1902.

HATCH EXPERIMENT STATION

OF THE

Massachusetts Agricultural College,

AMHERST, MASS.

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The co-operation and assistance of farmers, fruit-growers, horticulturists, and all interested, directly or indirectly, in agriculture, are earnestly requested. The Bulletins will be sent free to all newspapers in the State and to such individuals interested in farming as may request the same. General bulletins, fertilizer analyses, analyses of feed-stuffs, and annual reports are published. Kindly indicate in application which of these are desired. Communications may be addressed to the

Hatch Experiment Station, Amherst. Mass.

Fungicides, Insecticides, and Spraying Calendar.

George E. Stone, Henry T. Fernald, Samuel T. Maynard.

This bulletin contains a compilation of fungicides and insecticides taken from various sources and the usual spraying calendar. Many of these mixtures can be obtained already prepared from reliable dealers which saves much time and trouble in mixing them. The following precautions should be taken into consideration:

1. Care should be taken to keep all substances employed in spraying where they cannot be gotten at and used by mistake. All substances should be correctly labeled.

2. Solutions and mixtures containing copper sulfate, corrosive sublimate, and arsenate of lead should be made in wood, glass or earthern vessels.

3. Arsenical solutions should not be applied to fruits, etc. within two weeks of the time when they are to be used as food.

4. Trees should not be sprayed when they are in blossom as the bees which are necessary to fertilize the flowers may be destroyed.

FUNGICIDES.

1. BORDEAUX MIXTURE

4 pounds copper sulphate (blue vitriol).
4 pounds lime (unslaked).
25–50 gallons water.

Dissolve the copper in hot or cold water using a wood or earthern vessel. Slake the lime in a tub, adding the water cautiously and only in sufficient amount to insure thorough slaking. After thoroughly slaking more water can be added and stirred in until it has the consistency of thick cream. When both are cold pour the lime into the diluted copper solution of required strength, straining it through a fine mesh sieve or a gunny cloth and thoroughly mix. The standard mixtures are:

(a). 25 gallons (full strength solution, or 4–4–25 formula).

(b). 50 gallons, (half strength mixture, or 4–4–50 formula).

It is then ready for use. Considerable trouble has frequently been experienced in preparing the Bordeaux Mixture. Care should be taken that the lime is of good quality and well burned and has not been air slaked. Where small amounts of lime are slaked it is advisable to use hot water. The lime should not be allowed to become dry in slaking, neither should it become entirely submerged in water. Lime slakes best when supplied with just enough water to develop a large amount of heat which renders the process active. If the amount of lime is insufficient, there is danger of burning tender foliage. In order to obviate this the mixture can be tested with a knife blade or with ferro-cyanide of potassium (1 oz. to 5 or 6 oz. of water). If the amount of lime is insufficient, copper will be deposited on the knife blade, while a deep brownish-red color will be imparted to the mixture when ferro-cyanide of potassium is added. Lime should be added until neither reaction occurs. A slight excess of lime, however, is desirable.

The Bordeaux Mixture is best when first prepared. Stock solutions of lime and copper can be made, and mixed when required.

2. The following known as the 6–4–50 formula is in very general use:

6 pounds copper sulphate.
4 pounds lime.
50 gallons water.

3. BORDEAUX MIXTURE FOR PEACH FOLIAGE.

The Bordeaux Mixture as ordinarily applied frequently injures to some extent the foliage of the peach etc. causing a shot-hole effect on the leaves. This injurious effect has been shown to be largely obviated by the use of the following:

3 pounds copper sulphate.
6 pounds lime.
50 gallons water.

This is known as the 3–6–50 formula. Some experimenters have also recommended the following for peach foliage:

(a). 2–2–50 formula, (Cornell Agr. Exp. Sta. Bull. 180).

(b). 3–9–50 formula.

The latter contains three times as much lime as copper sulphate.

4. BORDEAUX RESIN MIXTURE.

5 pounds resin.
1 pound potash lime.
1 pint fish oil.
5 gallons water.

To make resin solution place resin and oil in a kettle and heat until resin is dissolved. Cool slightly and then add lye slowly and stir. Again place the kettle over the fire, add the required amount of water, and allow the whole to boil until it will mix with cold water forming an amber-colored solution. Take 2 gallons of the resin solution and add to it 10 gallons of water. Mix this with 40 gallons of Bordeaux Mixture.

Recommended for Asparagus Rust on account of its adhesive properties. (N. Y. Agr. Exp. Sta. (Geneva) Bull. 188).

5. SACCHARATE OF COPPER.

4 pounds copper sulphate.
4 pounds lime.
4 pints molasses.
25 gallons water.

Slake 4 pounds of lime and dilute the same with water. Dissolve 4 pints of molasses in a gallon of water and mix with the lime. Stir thoroughly and let it stand for a few hours. Dissolve 4 pounds of copper in 10 gallons of water and pour into it the lime-molasses solution while stirring briskly. Allow the mixture to settle. Draw off the clear greenish solution for use. Recommended in France as a substitute for the Bordeaux Mixture.

6. AMMONIACAL COPPER CARBONATE.

5 ounces copper carbonate.
3 pints ammonia (26° Beaumè).
50 gallons water.

Dissolve the copper carbonate in ammonia. This may be kept any length of time in a glass stoppered bottle and can be diluted to the required strength. The solution loses strength on standing.

7. EAU CÉLESTE.

(*Blue Water*).

2 pounds copper sulphate.
1 quart ammonia.
50 gallons water.

Dissolve the copper sulphate in 6 or 8 gallons of water, then add the ammonia and dilute to 50 or 60 gallons of water.

8. COPPER CARBONATE MIXTURE.

1 pound copper carbonate.
40 gallons water.

Mix the copper carbonate with a small quantity of water to make a paste; then dilute with the required amount of water. For fruit rot of the peach, etc. (Delaware Agr. Exp. Sta. Bull. XXIX).

9. COPPER ACETATE.

6 ounces copper acetate (Dibasic acetate).
50 gallons water.

First make a paste of the copper acetate by adding water to it, then dilute to the required strength. Use finely powdered acetate of copper, not the crystalline form. For the same purpose and of the same value as the preceding formula.

10. COPPER SULPHATE SOLUTION.

(*Strong Solution*).

1 pound copper sulphate.
25 gallons water.

Applied only on trees without foliage.

11. COPPER SULPHATE SOLUTION.

(*Weak Solution*).

2–4 ounces copper sulphate.
50 gallons water.

For trees in foliage.

12. POTASSIUM SULPHIDE.

3 ounces potassium sulphide.
10 gallons water.

Valuable for gooseberry mildews, etc.

13. POTASSIUM PERMANGANATE.

1 part potassium permanganate.
2 parts soap.
100 parts water.

Recommended in France for Black-rot and Mildew of the grape, etc.

14. IRON SULPHATE AND SULPHURIC ACID.

Water (hot) 100 parts.
Iron sulphate, as much as will dissolve.
Sulphuric acid, 1 part.

Prepare solution just before using. Add the acid to the crystals and then pour on the water. Valuable for treatment of dormant grape vines affected with Anthracnose, application being made with sponge or brush.

15. CORROSIVE SUBLIMATE.

(*For Potato Scab*).

2 ounces corrosive sublimate.
15 gallons water.

Dissolve the corrosive sublimate in 2 gallons of hot water, then dilute to 15 gallons, allowing the same to stand 5 or 6 hours during which time thoroughly agitate the solution several times. Place the seed potatoes in a sack and immerse in the solution for $1\frac{1}{2}$ hours. Corrosive sublimate is very poisonous, consequently care should be taken in handling it nor should the treated potatoes be eaten by stock. The solution should not be made in metallic vessels.

16. FORMALIN.

(*For Potato Scab*).

8 ounces formalin (40 per cent solution).
15 gallons water.

Used for the same purpose as corrosive sublimate, but not poisonous. Immerse the seed potatoes for 2 hours.

INSECTICIDES.

17. PARIS GREEN.—DRY.

1 pound Paris green.
20–50 pounds flour.

Mix thoroughly and apply evenly; preferably when dew is on the plants.

18. PARIS GREEN.—WET.

1 pound Paris green.
1–2 pounds quick lime.
200 gallons water.

Slake the lime in part of the water, sprinkling in the Paris green gradually, then add the rest of the water. For the peach and other tender leaved plants use 300 gallons of water. Keep well stirred while spraying.

19. ARSENITE OF LIME.

1 pound white arsenic.
2 pounds fresh burned lime.
1 gallon water.

Boil together for 45 minutes and keep in a tight vessel. Add one quart of this to a barrel (50 gallons) of water for use.

This insecticide has been recommended by a number of Experiment Stations, but has not as yet been sufficiently tested at the Massachusetts Station to receive an endorsement.

20. ARSENATE OF LEAD.

4 ounces arsenate of soda (50% strength).
11 ounces acetate of lead.
150 gallons water.

Put the arsenate of soda in 2 quarts of water in a wooden pail, and the acetate of lead in four quarts of water in another wooden pail. When both are dissolved, mix with the rest of the water. Warm water in the pails will hasten the process. For the Elm-leaf Beetle use 25 instead of 150 gallons of water.

21. WHALE OIL SOAP.

2 pounds potash whale oil soap.
1 gallon hot water.

For winter use only.

22. KEROSENE EMULSION.

½ pound hard soap, shaved fine.
1 gallon water.
2 gallons kerosene.

Dissolve the soap in the water which should be boiling; remove from the fire and pour it into the kerosene while hot. Churn this with a spray pump till it changes to a creamy, then to a soft butter-like mass. Keep this as a stock, using one part in nine of water for soft bodied insects such as plant lice, or stronger in certain cases.

23. MECHANICAL EMULSION.

A substitute for the last. Made entirely by the pump, which draws water and kerosene from separate tanks and mixes them in the desired proportion by a mechanical device. Several pumps for this purpose are now on the market.

24. RESIN-LIME MIXTURE.

5 pounds pulverized resin.
1 pound concentrated lye.
1 pint fish or other animal oil.
5 gallons water.

Place the oil, resin and 1 gallon of hot water in an iron kettle and heat till the resin softens: then add the lye and stir thoroughly; now add 4 gallons of hot water and boil till a little will mix with cold water and give a clear, amber colored liquid: add water to make up 5 gallons. Keep this as a stock solution. For use, take

1 gallon stock solution.
16 gallons water.
3 gallons milk of lime.
¼ pound Paris green.

The object of this preparation is to obtain an adhesive material which will cause the poison to adhere to smooth leaves. It has been highly recommended by the New York State (Geneva) Experiment Station.

25. LIME, SALT AND SULPHUR.

Oregon Formula.

50 pounds unslaked lime.
50 pounds flowers of sulphur.
50 pounds common salt.

Slake the lime in enough water to do it thoroughly; add the sulphur and boil for an hour at least, adding water if necessary. Then add the salt and boil 15 minutes more. Add water to make 150 gallons and spray hot through a coarse nozzle.

26. LIME, SALT AND SULPHUR.

Marlatt's Formula, (from Smith.)

30 pounds unslaked lime.
30 pounds sulphur.
15 pounds salt.
60 gallons water.

Boil with steam for four hours and apply hot.

27. CARBOLIC ACID EMULSION.

1 pound hard soap shaved fine.
1 gallon water.
1 pint crude carbolic acid.

Dissolve the soap in the water, boiling; add the carbolic acid and churn as for kerosene emulsion. Use one part of this with 30 parts of water.

28. HELLEBORE.

1 ounce hellebore.
1-2 gallons water.

Steep the hellebore in a pint of water and gradually add the rest of the water. Hellebore may also be dusted over the plants, either pure or mixed with flour or plaster.

29. INSECT POWDER. PYRETHRUM.

Mix with half its bulk of flour and keep in a tight can for 24 hours; then dust over the plants. Or,

100 grains insect powder.
2 gallons water.

Mix together and spray.

COMBINED

FUNGICIDES AND INSECTICIDES.

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30. BORDEAUX MIXTURE AND PARIS GREEN.

4 ounces Paris green.
50 gallons Bordeaux Mixture.

31. BORDEAUX MIXTURE AND ARSENATE OF LEAD.

1 gallon Arsenate of Lead (made by formula No. 20).
50 gallons Bordeaux Mixture.

32. BORDEAUX MIXTURE AND ARSENITE OF LIME.

1½ quarts Arsenite of Lime (made by formula No. 19.)
50 gallons Bordeaux Mixture.

33. IVORY SOAP.

1 bar Ivory soap, (10 cent size).
15 gallons water.

Apply warm as it thickens on cooling.

Recommended for rose mildew, red spider, plant lice, etc. E. O. Orpet: see Am. Gard. Feb. 8, 1902.

SPRAYING CALENDAR.

PLANT.	FIRST APPLICATION.	SECOND APPLICATION.
APPLE . . . . . (*Scab, codling moth, bud moth, tent caterpillar, canker worm, plum curculio, San Jose scale.*)	Before buds swell, No. 10, When buds are swelling, No. 1, b. For scale, No. 23, 25% before leaves unfold.	For canker worm and plum curculio just before blossoms open, No. 30 or 31.
ASPARAGUS . . . . . (*Rust.*)	Use No. 4, on all young beds at intervals of 2 to 4 weeks from May to Sept. according to weather.	After cutting use No. 1, b, or No. 4.
BEAN . . . . . (*Anthracnose, leaf blight.*)	When third leaf expands, No. 1, b.	10 days later, No. 1, b.
CABBAGE . . . . . (*Worms, club root.*)	No. 29. dry for worms. Lime 35 bu. per acre for club root.	7-10 days later, repeat No. 29 dry.
CARNATION . . . . . (*Rust and other fungous diseases.*)	No. 1, b, in field at intervals of from 1 to 2 weeks according to weather.	
CELERY . . . . . (*Rust and blight.*)	Spray in seed bed with No. 1, b, every two weeks.	Dip plants in No. 1, b, before planting.
CHERRY* . . . . . (*Rot, aphis, slug, plum curculio, black knot.*)	As buds are breaking, No. 1, b, when aphides appear, No. 23.	When fruit has set. No. 31 and if slugs appear, dust leaves with air slacked lime or hellebore.
CURRANT } GOOSEBERRY } . . . . . (*Worms, leaf blight, mildew.*)	Spray bushes with No. 1, b, before leaves start. At first appearance of worms, No. 28.	10 days later, No. 1 and 28. For mildew, No. 12.
ELM . . . . . (*Leaf beetle.*)	As soon as leaves are formed use No. 20.	
GRAPE . . . . . (*Fungous diseases, rose bug, etc., leaf hopper.*)	In spring when buds swell, No. 1 and 14.	Just before flowers unfold, No. 30.
NURSERY STOCK . . . (*Fungous diseases.*)	When first leaves appear, No. 1, b. and No. 30 or 31.	10-14 days, repeat. For scale treat as for apple.
PEACH, APRICOT, } NECTARINE } . . . (*Rot, mildew, scab; leaf curl, curculio.*)	As the buds swell, for plum curculio, No. 3 and 20.	When fruit has set, No. 3 and 31 for curculio.
PEAR . . . . . (*Leaf blight, scab, psylla, codling moth, blister mite, slug.*)	As buds are swelling, No. 1, b.	Just before blossoms open, No. 30, when leaves open for psylla, No. 23.
PLUM*† . . . . . (*Curculio, black knot, leaf blight, brown rot, San Jose scale.*)	When buds are swelling, No. 1, b. Before buds swell, No. 23 or 21 for scale.	When blossoms have fallen, No. 31.
QUINCE . . . . . (*Leaf and fruit spot.*)	When blossom buds appear, No. 1 and No. 30.	When fruit has set, No. 30.
RASPBERRY } BLACKBERRY } . . . . . DEWBERRY } (*Rust, anthracnose, leaf blight*)	Before buds break, No. 1, b.	Just before the blossoms open No. 30.
ROSE . . . . . (*Rose-mildew, red spider.*)	No. 33, whenever these pests appear.	
STRAWBERRY . . . . . (*Rust, Black Paria, etc.*)	As soon as growth begins, with No. 1, b. Dip plants in No. 1, before setting.	When first blossoms open spray both young and old plantation, No. 30.
TOMATO . . . . . (*Rot, blight, flea beetle.*)	Soon after planting use No. 1, b.	Repeat as soon as fruit is formed. Fruit can be wiped if disfigured by No. 1, b.
POTATO . . . . . (*Flea beetle, Colorado beetle, blight and rot, scab.*)	Spray with No. 30, when about one-half grown. For scab No. 15 or 16,	Repeat before insects become too numerous.
VIOLET . . . . . (*Spot, red spider.*)	Use No. 33, on first appearance of spot or insects.	

*Paris green cannot be used on foliage of cherry, peach, Japanese plum, apricot and nectarine without injury.

†Black knots on plums or cherries should be cut and burned as soon as discovered.

THIRD APPLICATION.	FOURTH APPLICATION.	FIFTH APPLICATION.
When blossoms have fallen repeat second.	8-12 days later, No. 1, b, 30 or 31. For scale, No. 23, 15% every two weeks, up to Oct. 15th.	10-14 days later, No. 1, b. Use dilute No. 11 solution in Sept. for scab if season is wet.
14 days later, No. 1, b.	14 days later, No. 1, b. Spraying with No. 1, b, after the pods are one-half grown will injure them for market.	
7-10 days later, repeat second.	Repeat in 10-14 days, if necessary second.	
Use No. 1, b, until banking begins every two weeks.		Freedom from disease depends largely upon good cultivation and an abundance of plant food in the soil.
10-14 days if rot appears, No. 31, for plum curculio.	10-14 days later, No. 11. For scale treat as for apple.	Repeat after every rain when fruit begins to color.
If worms persist, No. 28.	2 to 4 weeks later, if any disease appears.	After fruit is gathered, No. 1, b.
Repeat a month later.	Two seasons needed to extinguish this pest.	
When fruit has set, No. 30. For leafhopper, No. 22, 15%.	2 to 4 weeks later, No. 11.	No. 11, as fruit is coloring.
10-14 days. repeat.	10-14 days repeat. For scale treat as for apple.	5-7 days later, repeat.
When fruit is one-half grown, No. 3, a or b.	5-7 days later, No. 12.† For scale treat as for apple.	10-14 days later, No. 11.
After blossoms have fallen, if necessary, No. 23.	8-12 days later, repeat third. For scale treat as for apple.	10-20 days later, No. 11.
10-14 days later, No. 31.	10-20 days later, No. 31. For scale treat as for apple.	10-20 days later, as fruit is ripening.
10-20 days later No. 1. b.	10-20 days later, No. 1, b.	
(Orange or red rust is treated best by destroying the plants attacked in its early stages.)	Spray after fruit is gathered with No. 1.	10-20 days later, repeat.
Spray new plantation, No. 1, b.	Repeat third if weather is moist.	
Repeat first when necessary.	Try weak solution† of copper sulfate as fruit begins to ripen.	
Repeat for blight, rot and insects as potatoes approach maturity.		

†If a pailful of lime wash, well strained, be added to each barrel full of copper solution—4 ounces to 50 gallons—delicate foliage like that of the peach, etc., will not be injured.